# CERAMIC ABSTRACTS and THE BULLETIN

OF THE

# AMERICAN CERAMIC SOCIETY

NOVEMBER 15, 1943

MONTHLY PUBLICATION DEVOTED TO THE ARTS AND SCIENCES RELATED TO THE SILICATE INDUSTRIES

Foreman checks hardening temperature by glance at the furnace's automatic Micromax Controller.

# 4 WAYS *in which we can help* WHEN HEAT-TREATING IS BEING PLANNED

Here are some conditions in the control of temperature which many ceramic manufacturers check, in converting a ceramic furnace for heat-treatment of metals.

1. Automatic control and recording of temperature is standard practice for good heat-treating. Manual indicators for thermocouples, and an Optical Pyrometer, are also standard equipment, but they are generally only accessories in the metals industries; the control is by an automatic pyrometer, which provides its own record in addition to any temperature readings shown on the operator's log sheet . . . The best practice of the industry is to turn this joint control and recording task over to a Micromax Pyrometer. Its micro-responsiveness, suitability to any furnace or fuel, slight maintenance requirements and complete dependability make it especially suitable for rush production of high-quality work.

2. A ceramic kiln's automatically-controlled valves may have to be replaced, moved or changed in number or type, for heat-treating work. Micromax Pyrometer engineers can help substantially in these problems.

3. Thermocouples may need to be relocated or changed in length. Platinum couples, with their double protection tubes, may give way to base-metal ones in single tubes. Rayotubes may need to be changed; you may or may not need to supplement them with couples. As makers of every standard type of metallurgical couple, in every length and size, and as perfectors of the radiation-type pyrometer, we are glad to be consulted in these matters.

4. New Problems in draft and furnace pressure are almost certain to arise, and many of them can be solved effectively by L&N Furnace Pressure Controllers.

Other problems will appear, due to the many differences in weight and bulk, in heating and cooling speeds, in transformation points, etc., between metals and ceramic materials. In some ways, metals are easier to heat than ceramics; in some ways harder. But the men and furnaces of the ceramic industry are doing heat-treatment with great success, and we are proud to be helping them. If you have a problem, perhaps we can help you.

Jrl Ad N-33-620(4C)

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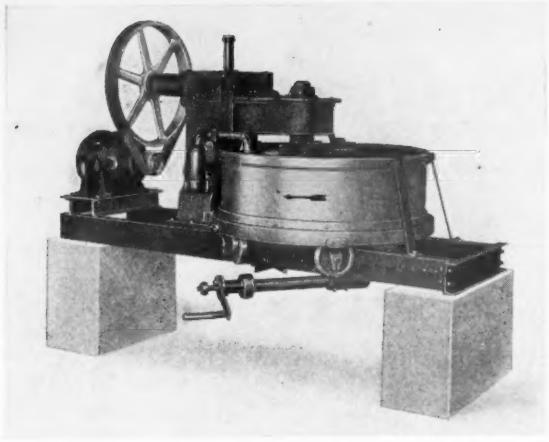

**(Left)** ***Symbol "EB" Lancaster Mixer:*** **standard open pan type.**

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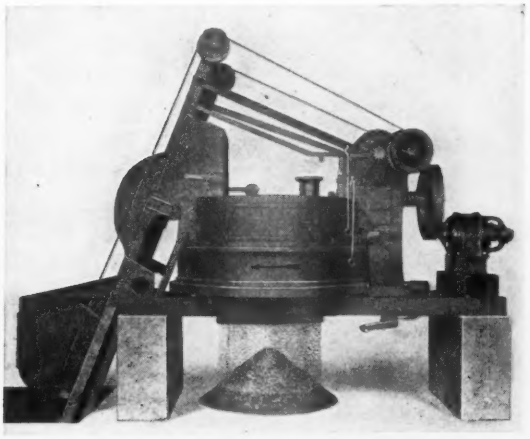

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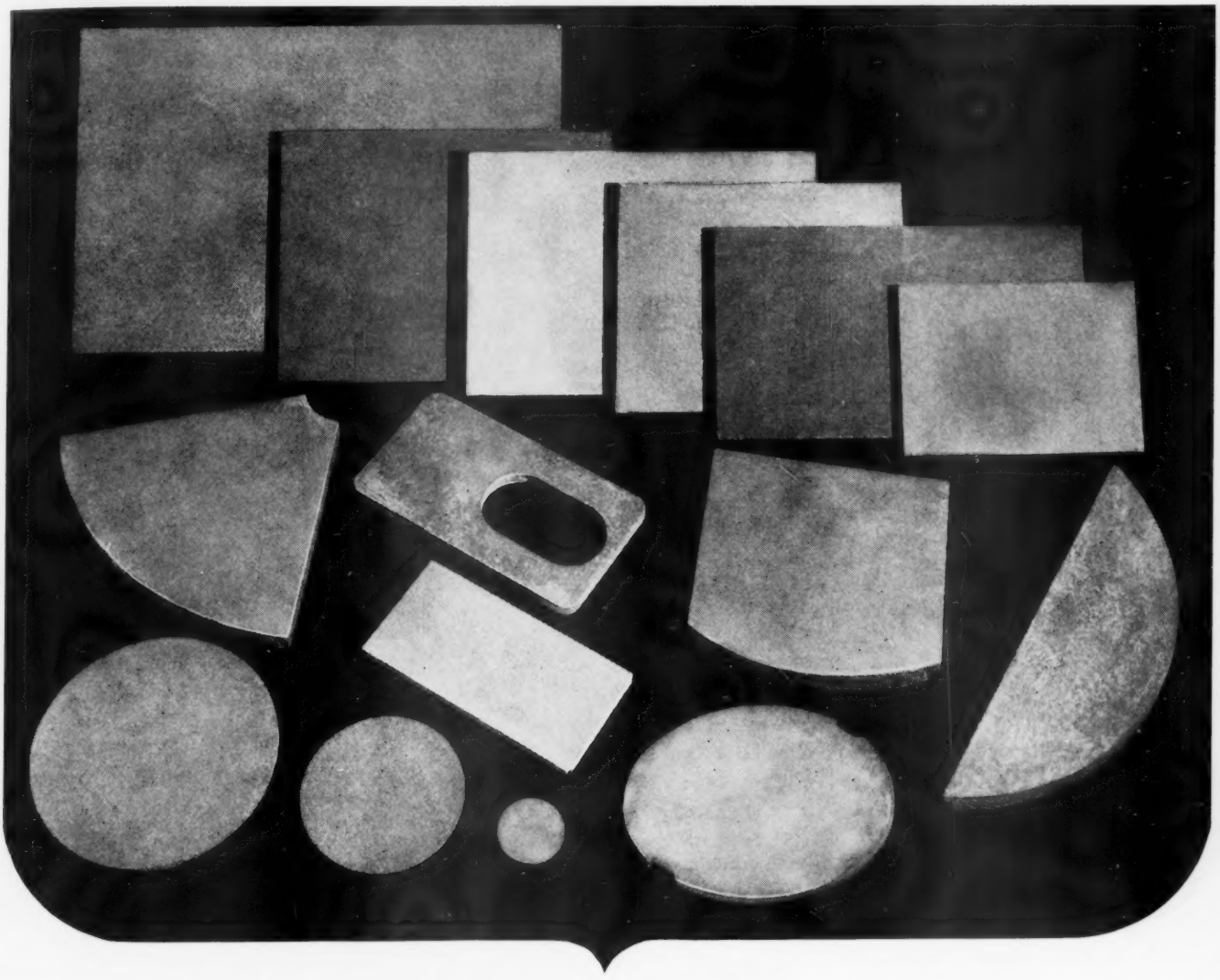

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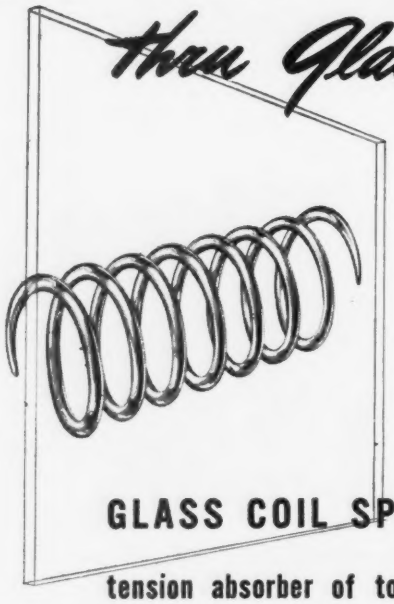


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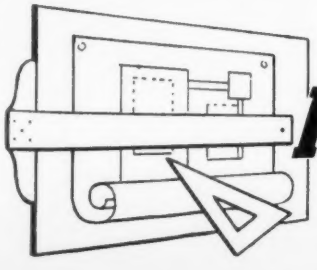

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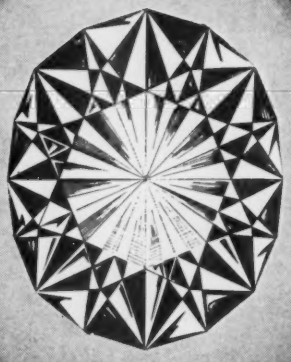

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* *"The Porcelain Enamel & Mfg. Co., Baltimore, Maryland; Chicago Vitreous Enamel Product Co., Cicero, Illinois; Ingram-Richardson Mfg. Co. of Indiana, Inc., Frankfort, Indiana; and American Porcelain Enamel Co., Muskegon, Michigan are licensed under U. S. Patents No. 1,848,567 and 1,944,938 held by the Titanium Alloy Manufacturing Company, and other patents pending, for the manufacture of zircon type enamel frits."*

| | Furnace A | Furnace B | Furnace C | Furnace D | Furnace E | Average | Your Furnace ? |
|---|---|---|---|---|---|---|---|
| TOTAL LIFE | 678 | 1069 | 920 | 884 | 984 | 907 | |
| OPERATING DAYS | 629 | 1006 | 839 | 833 | 964 | 854.2 | |
| IDLE DAYS | 49 | 63 | 81 | 51 | 20 | 52.8 | |
| MELTING AREA | 392 | 378 | 522 | 504 | 504 | 460 | |
| TOTAL TONS PRODUCED | 45825 | 74137 | 63940 | 65011 | 82582 | 66299 | |
| SQ. FT./TON/DAY | 5.38 | 5.13 | 6.84 | 6.46 | 5.88 | 5.94 | |
| TON/SQ. FT./LIFE | 116.9 | 196.1 | 122.49 | 128.9 | 163.73 | 145.6 | |


# Five Campaigns Point To ONE Conclusion!

THE chart above gives the vital statistics for five recent complete campaigns on several tanks operated by one flint glass container manufacturer. All the furnaces were "complete balanced Corhart Electrocast units."

The average figures, at the right, are not only interesting —they indicate possibilities for every operator of glass tanks. The long average life of 907 days, at the very high average production rate of 5.94 square feet per ton, is especially significant.

Also, the factor "tons-per-square-foot, per life", offers a very handy means by which any manufacturer can compare his own furnaces' performances. This factor reasonably applies to all furnaces, regardless of size. The national average, some 15 years ago, was certainly not more than 40 tons. The average for the five furnaces above is 145.6 — an average which represents the industry's very noteworthy progress in the technique of efficient glass-making.

Corhart does not claim that these advances are solely due to the refractories used. But, in our opinion, the conclusion is that sound engineering, good melting practice, *plus* the judicious selection of refractories which can withstand punishment, are the factors that make such performances possible.

Corhart Refractories Company, *Incorporated,* 16th and Lee Streets, Louisville 10, Kentucky.

QUALITY ECONOMY ENDURANCE

CORHART ELECTROCAST REFRACTORIES

# Ceramic Abstracts Section

Compiled by

## THE AMERICAN CERAMIC SOCIETY


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**Vol. 22** **November 15, 1943** **No. 11**


## Abrasives

PATENTS

**Abrading and polishing device.** A. C. BURLEIGH (Skilsaw, Inc.). U. S. 2,328,613, Sept. 7, 1943 (May 2, 1940).

**Flexible grinder or sander.** J. G. FLORACK. U. S. 2,330,209, Sept. 28, 1943 (Oct. 3, 1941).

**Form grinding machine.** F. A. WARD (Gear Grinding Machine Co.). U. S. 2,329,428, Sept. 14, 1943 (Jan. 6, 1941).

**Grinding apparatus.** ERNEST HUFF (Wehr Steel Co.). U. S. 2,329,905, Sept. 21, 1943 (March 27, 1942).

**Grinding combination and device.** WILLIAM FAVINI (A. D. Mizzy). U. S. 2,329,191, Sept. 14, 1943 (July 1, 1941).—A grinding device for grinding a taper.

**Grinding machine.** R. H. CRAMER (General Motors Corp.). U. S. 2,330,809, Oct. 5, 1943 (March 13, 1941). C. G. FLYGARE AND C. J. GREEN (Norton Co.). U. S. 2,331,089, Oct. 5, 1943 (Jan. 15, 1942).

**Grinding twist drills and machine therefor.** F. A. EICH AND F. E. HIGGINS (United Shoe Machinery Corp.). U. S. 2,328,549, Sept. 7, 1943 (July 29, 1940).

**Improved abrasive and its production.** BABCOCK & WILCOX CO. Belg. 438,185, April, 1940.—A siliceous and an aluminous material are calcined in a manner to form microscopic crystals of aluminum silicate dispersed in an amorphous material. The product is then ground fine. This abrasive is used for polishing glass. M.Ho.

**Inside hone for cylinders.** R. R. HAUSE (Reconstruction Finance Corp.). U. S. 2,330,184, Sept. 21, 1943 (May 5, 1941).

**Internal grinding machine and method.** W. D. SCHMIDT AND R. A. ST. JOHN (Heald Machine Co.). U. S. 2,329,301, Sept. 14, 1943 (April 18, 1939).

**Lapping machine.** G. F. JOHNSON (Bower Roller Bearing Co.). U. S. 2,328,809, Sept. 7, 1943 (May 23, 1941).

**Lapping tool.** F. F. HILLIX (American Steel & Wire Co. of New Jersey). U. S. 2,329,720, Sept. 21, 1943 (April 10, 1939; Aug. 15, 1942).

**Lens-edging device.** L. W. GODDU (American Optical Co.). U. S. 2,329,713, Sept. 21, 1943 (May 27, 1939; Jan. 17, 1942).

**Manufacture of abrasive articles.** R. C. BENNER AND R. L. MELTON (Carborundum Co.). U. S. 22,373, Sept. 14, 1943 (March 10, 1942); reissue of original U. S. 2,193,265 (*Ceram. Abs.*, **19** [5] 103 (1940)).—The method of manufacturing a metal bonded abrasive article comprising the steps of spraying an unsized abrasive-coated web with metal, peeling off the backing web, assembling successive layers of the metal bonded abrasive granules into the desired shape, and then applying heat and pressure to compact the mass.

**Manufacture of granular-coated webs.** A. ABBEY (Carborundum Co.). Brit. 555,010, Aug. 11, 1943 (Jan. 27, 1942).

**Means for grinding taps, etc.** J. A. PHILLIPS & CO. AND W. FIELD. Brit. 555,568, Sept. 8, 1943 (Oct. 2, 1942).

**Polishing disk.** K. F. SCHLEGEL, JR. (Schlegel Mfg. Co.). U. S. 2 329,222, Sept. 14, 1943 (Jan. 6, 1942).

**Removing intergranular graphite from boron carbide.** J. A. BOYER AND C. G. ROSE (Carborundum Co.). U. S. 2,328,780, Sept. 7, 1943 (Feb. 14, 1940).

**Thread-grinding machine.** SOC. GENEVOISE D'INSTRUMENTS DE PHYSIQUE. Brit. 555,469, Sept. 8, 1943 (July 2, 1942).

**Valve seat grinding device.** H. G. MILLER. Brit. 555,-066, Aug. 18, 1943 (Feb. 7, 1941).

## Art and Archeology

**Calculation of color in pigmented plastics.** J. T. SAUNDERSON. *Jour. Optical Soc. Amer.*, **32** [12] 727–36 (1942).—The two-constant theory describing the optical properties of pigmented media is discussed for the special case of an opaque sample. S. presents a method for determining the optical constants of dyes and pigments which is not too complicated for industrial use. Examples are given of the calculation of the color of pigment mixtures and of the method used by S. for making color matches. A.P.

**Color-mixing systems. Color versus colorant mixture.** D. R. DOHNER AND C. E. FOSS. *Jour. Optical Soc. Amer.*,

**32** [12] 702–708 (1942).—What has the physicist done for the artist in methods of exact charting of color and color mixture? Think of color-mixture systems plotted on diagrams as maps. No one map can be expected to have everything desired on it. The one giving maximum information with minimum disadvantages is at present the I.C.I. system. The I.C.I. ($x$, $y$) diagram adequately specifies only the chromaticity of a sample, the quality of the light but not its quantity or visual appearance. Colorants merely control light. They should be judged not on the basis of their apparent color when separate but on their contribution to the mixture. The result of mixing colorants ("subtractive" mixtures) cannot be forecast in the exact manner of color mixtures ("additive"). Selective absorption, refractive index, particle size, etc., affect the results. The shape of colorant-mixture curves cannot be predicted except upon the basis of experience with the particular colorants involved. An understanding of color mixture and of colorant mixture, with the consequent ability to plot and plan so as to arrive directly at the goal, should be to the artist what the ability to make and read maps is to the explorer, but it cannot substitute for the creative impulse. A.P.

**Color-order systems, Munsell and Ostwald.** M. E. BOND AND D. NICKERSON. *Jour. Optical Soc. Amer.*, **32** [12] 709–19 (1942).—Both Munsell and Ostwald insist that the study of color as sensation, in art use, shall be based on an orderly arrangement of the visual attributes of color, independent of colorants or of light. Ostwald developed his system during the first World War. The Ostwald Atlas produced in 1920 contained the system as it is known today, but a complete bibliography of his writings on color occupies 23 pages. The system has been studied by a number of scientists and many points have been criticized, but it is of practical value in art education. The notation of the Munsell system is so simple and yet has possibilities of such accuracy that the system has become increasingly important in industrial, commercial, and scientific work as well as in art education. The broadening of the world of color possibilities is one of the best contributions of the Munsell solid. The Munsell system is more useful than the Ostwald system for several reasons. Many teachers can use the Ostwald system more successfully in teaching color harmony, but the Munsell system can be adapted to the same ends. It is the concept of each system that is important; its use may be varied and individual. A.P.

**Emotions versus measurement in teaching color.** NORMAN C. MEIER. *Jour. Optical Soc. Amer.*, **32** [12] 699–702 (1942).—In the teaching of color, scientific data offer much to the serious minded art student, who should learn all he can concerning the systems of mixing colorants, the theories of color, and even the measurement of color sense quanta. Two experimental procedures proposed are adaptable to art-school facilities for teaching color: (1) The utilization of spectral colors originating from two sides, so that by mirror deflection the projected colors appear in the subject's line of regard, one as a ground color and the other increasing from a point until maximum pleasantness is reached; this method could be used by industry to find what color combinations are most popular. (2) The application of fixed and variable color to objects and settings and also the fusing of settings with supplementary backgrounds projected from the rear onto a transparent screen; $n$ variations and combinations of the primary colors may be produced, as well as flood and pencil-spot accessory sources. The apparatus has value as an instrument for individual trial-and-error planning of compositions and for group demonstration of color properties and phenomena. A.P.

**New England handicrafts exhibit.** ANON. *Bull. Amer. Ceram. Soc.*, **22** [10] 357–58 (1943).

**Popular history in American glass.** MARSHALL B. DAVIDSON. *Bull. Metropolitan Mus. Art*, **1** [3] 128–30 (1942).—Several hundred examples of Early American cup plates, bottles, and flasks have recently been added to the Museum's collections from the Constance R. Brown bequest. The cup plates were an entertaining fashion of the times and are now much sought after because of the interest in their patterns, subject matter, and techniques. They were easily made with the newly invented glass-pressing machine and make a pleasing record of the happenings and enthusiasms of those decades. Blown bottles and flasks, in many colors and shapes, served to make the products of the distilleries even more attractive than they were. They also commemorated events and honored famous people of the day. Illustrated. A.A.A.

**Pottery making. Indian style.** ANON. *Popular Science Monthly*, **143** [4] 94–95 (1943).—Among the best Indian pottery is the black ware of the Pueblos of San Ildefonso, N. Mex. Steps in molding, painting, and firing are illustrated by ten photographs. A.P.

**Results of a questionnaire on color in art education.** R. B. FARNUM. *Jour. Optical Soc. Amer.*, **32** [12] 720–26 (1942).—Approximately 150 persons engaged in teaching students of art on the higher education level were questioned on two topics: (1) What color facts shall be taught to art students? (2) What technical information and materials are desirable for color study? There appears to be no great uniformity in the teaching of color to prospective designers and artists. Color study is only incidental to technical practice. A.P.

**Water, ice, and glass.** CHARLES K. WILKINSON. *Bull. Metropolitan Mus. Art*, **1** [5] 175–83 (1943).—Water, ice, and glass were used in Nishapur in the 9th and 10th centuries. During the Museum's excavations at Nishapur, many glass drinking vessels were discovered, and there is evidence that much beautiful glass was made there. Water was brought in ditches from distant mountains for irrigation purposes, but the drinking water was ingeniously brought through underground tunnels. In ancient times these conduits were vaulted with square yellow brick, but later, as at present, they were lined with earthenware hoops consisting of flat pottery rings. A modern kiln where these are made, and a watercourse showing their use are illustrated. The Persian method of making and storing ice is described and illustrated. Several porous pottery drinking vessels with incised designs, two glass vessels, a cut-glass bottle, and a glass jug from the excavations at Nishapur are also described and illustrated. A.A.A.

PATENTS

**Design for combined coffee and tea maker.** F. E. WOLCOTT (Silex Co.). U. S. 136,404, Sept. 28, 1943 (Feb. 18, 1943).

**Making highly dispersable pigments for ceramics.** DEUTSCHE GOLD- UND SILBER-SCHEIDEANSTALT VORM. ROESSLER. Belg. 438,174, April, 1940; addition to Belg. 420,311.—An alkaline chromate solution is precipitated with a solution of a heavy metal at a temperature of 40° to 50°. The precipitate is washed and dried but not ignited. M.Ho.

## Cements

**Durability of cements in contact with brines and chemical solutions.** H. H. MILLER. *Petroleum Engr.*, **13** [12] 50, 52, 54 (1942); abstracted in *Fuel Research Intelligence Section, Summary for Two Weeks Ending Feb. 6 and 13, 1943*, p. 36; *Woodall-Duckham Tech. Press Rev.*, No. 897, p. 3 (March 10, 1943).—M. studied the durability of 27 different cements and mixtures in contact with typical oil-field brines and with 6% $Na_2SO_4$, $MgSO_4$, $Na_2SO_3$, NaCl, and $CaCl_2$.

**Gypsum and anhydrite.** R. L. SHERLOCK AND B. SMITH. *Geol. Survey Gt. Brit., Special Repts. Mineral Resources Gt. Brit. 1938*, **III**, pp. 1–76; *Chem. Abs.*, **32**, 6192 (1938).—The chemical composition, properties, uses, and methods of preparation of gypsum, anhydrite, and alabaster are described, followed by an account of the geology of the deposits, their position, and the chief mines. These occur on the Permian, Triassic, and Jurassic formations and seem always to have resulted from evaporation of

lakes with no outlet or isolated arms of the sea. Deposits are found chiefly in northwest and northeast England, the Midlands, and a few places in the south. Future yields and other possible deposits are discussed.

**High-strength gypsum.** I. A. Perederiĭ. *Prom. Stroitel. Materialov*, **1940**, No. 3, pp. 66–71; abstracted in *Chem. Zentr.*, **1940, II,** 946.—Gypsum composed of 89.32 $CaSO_4 \cdot 2H_2O$, 1.03 hygroscopic water, and 9.65% miscellaneous was crushed to adequate fineness and autoclaved at 124° for 6 hr. It was then dried at 120° for $2^1/_2$ hr. and ground until 64.7% passed the 4900-mesh sieve. Test pieces made with 30% water showed a tensile strength of 50.5 kgm. per sq. cm. and a resistance to compression of 293 kgm. per sq. cm. after 7 days. M.V.C.

**Lime and lime kilns.** E. W. Blank. *Jour. Chem. Education*, **17** [11] 505–508 (1940).—A brief survey of the important events in the history of lime production and of lime kilns is presented with special emphasis on the technological progress. S.Z.

PATENTS

**Acid-resisting cements.** R. Ward and Imperial Chemical Industries, Ltd. Brit. 551,408, March 3, 1943 (Aug. 18, 1941); abstracted in *Chem. Trade Jour.*, **112** [2918] 388 (1943).—Ethyl acetate added to acid-resisting cement of the inert aggregate and water soluble silicate type increases the tensile and shear strengths when the cement is in contact with sulfuric acid. Thus, 4 lb. acid-resisting brick dust (−240 B.S.) was gauged with 1 pint of aqueous sodium silicate (specific gravity 1.35); 120 cc. of ethyl acetate was added to accelerate its setting. A joint $^1/_{16}$ in. thick between two brick, cured in air, had a tensile strength of 129 lb. per sq. in., and three other joints left in 77% sulfuric acid for 3 days, 5 days, and 3 months broke at 73, 89, and 87 lb. per sq. in., respectively. A similar test in which the ethyl acetate was replaced by 2.5% by weight of sodium silicofluoride gave an air-set joint of 75 lb. per sq. in., but joints placed under acid failed to hold the brick together after 2 days. L.R.B.

**Waterproof cement.** Soc. Anon. des Ciments Luxembourgeois. Belg. 438,350, April, 1940.—To the mix used for making this cement, a calcium salt other than glycerate is added. This cement prevents the cracking of mortar in concrete made from it and at the same time makes it tight. M.Ho.

## Enamel

**Caulking compound development suggested.** R. M. King. *Enamelist*, **20** [10] 36, 44 (1943).—During an exposure test of porcelain enameled panels, 24 brands of caulking materials were tested. Six of these compounds showed some defects within 5 days, while 16 failed within 10 days; after two years only two could be considered as satisfactory. After $3^1/_2$ years' exposure none could be considered entirely satisfactory. K. stresses the necessity of the development of a more satisfactory caulking compound for architectural porcelain enamel. L.E.T.

**Development and use of luminescent substances.** L. Levy and D. W. West. *Endeavour*, **2** [5] 22–25 (1943).—A general account of luminescent phenomena deals especially with artificial substances, termed "phosphors," typical examples of which are zinc and zinc-cadmium sulfides and zinc and zinc-beryllium silicates. Phosphorescent vitreous enamels have been made, and similar developments in plastic switch covers, door handles, etc., are foreshadowed. L.R.B.

***Elements of a method of comparative ceramics.** R. Lecuir. *Compt. Rend.*, **212** [18] 762–64 (1941); abstracted in *Physik. Ber.*, **23** [3] 355 (1942).—Certain enamels on ceramic products can be characterized by the term "depth." The physicochemical significance of this property is that, by superposition of parallel more or less transparent layers on a ceramic surface, the impression of a characteristic depth is created owing to increasing diffusion. In this connection, a simultaneous contrast is also observed which is of particular charm in valuable east Asian ceramics. The consideration of this characteristic is important for comparative ceramics. M.Ha.

**Gas-heated enamel drying kilns.** Anon. *Nat. Gas Bull. Australia*, **6**, 4 (July-Aug., 1942); abstracted in *Woodall-Duckham Tech. Press Rev.*, No. 888, p. 6 (Jan. 6, 1943).—An illustrated description is given of two conveyer gas kilns installed by the Australian Gas Light Co. in Metters' vitreous enameling shop.

**Many graduate from Ferro Chemistry Course.** Anon. *Enamelist*, **20** [10] 20–21 (1943).—A concentrated, 8-week course to prepare men and women for laboratory work to aid the war effort has been offered by the Ferro Enamel Corp., Cleveland, Ohio, and sponsored by Fenn College of Cleveland under the Government Engineering, Science, and Management War Training Program (E.S.M.W.T.). M. J. Bozsin of the Ferro Enamel Corp. serves as instructor. L.E.T.

**Mechanics of enamel adherence: XV, Influence of cobalt and nickel oxides on metal precipitation at ground coat-iron interface.** R. M. King. *Jour. Amer. Ceram. Soc.*, **26** [10] 358–60 (1943).—3 references, 2 figures.

*Obtained from microfilm.

**Organizing to promote and market architectural porcelain enamel.** John C. Maddox. *Enamelist*, **20** [20] 9–13 (1943).—M. discusses the basic problems in developing the market for architectural porcelain enamel. The need for product research and technical data, a study of costs and profits, and an over-all plan of distribution are stressed. L.E.T.

**Porcelain enamel still fresh appearing after four years.** Anon. *Enamelist*, **20** [8] 14–17 (1943).—The Clairton Housing Project (Colonial Village), Clairton, Pa., where 300 houses were built in 1938 and 1939 with extensive use of enameled shutters, entrance canopies, cornerboards, rakes, cornices, and other enameled trim, still looks fresh and colorful. The enamel-trimmed houses are in excellent condition and look much the same as the day they were built. Porcelain enameled kitchens, bathrooms, and plumbing fixtures are likewise in good condition. 4 illustrations. L.E.T.

**Porcelain enamelers should keep their eye on the prefabricated house.** Anon. *Enamelist*, **20** [9] 5 (1943).—Many persons are looking forward to prefabricated houses as a major opportunity after the war. About $150,000,000 worth of demountable houses were completed in the last year. Because most porcelain enameled items go into the home, there appear good possibilities in this building industry. L.E.T.

**Postwar building—a challenge to the porcelain enameling industry.** Richard N. Jones. *Enamelist*, **20** [11] 13–17, 32–40 (1943).—The porcelain enameling industry must some day address dominating promotional campaigns of an educational nature to the designing, engineering, and construction minds among building practitioners to stimulate their imagination toward a more extensive use of porcelain enameled products in all types of construction in postwar building. Several illustrations of prefabricated units are shown. L.E.T.

**Postwar outlook for enameled metals.** L. S. Hamaker. *Better Enameling*, **14** [6] 15–18 (1943).—There will be a great postwar demand for enameled metals despite the progress made in competitive materials, which in most cases are inferior in quality and compete solely on a cost basis. Efforts should be made to find cheaper methods of applying enamel to metals, such as lower firing temperatures and fewer processing steps. Encouraging results have been already obtained in the elimination of the ground coat. The steadily increasing requirements for enameled materials plus a large public savings should provide adequate business for the enamel industry in the postwar period. B.C.R.

**Setting up for low-temperature ceramic finishes.** W. A. Barrows. *Better Enameling*, **14** [6] 3–6 (1943).—B. describes a plant layout for using the recently developed

low-temperature ceramic finish, Armor-Vit. This material provides a finish which bridges the gap between the high temperature porcelain enamels and the baked coatings of organic finishes. Although this finish fits well into wartime requirements, it also has excellent postwar possibilities. See "New . . . ," *Ceram. Abs.*, **22** [7] 114 (1943). B.C.R.

**Summer is time to plug fuel leaks in enamel plants.** ANON. *Ceram. Ind.*, **41** [2] 39 (1943).—Practical hints for the elimination of heat losses are given. H.T.

**Tank standard adopted.** ANON. *Enamelist*, **20** [8] 12–13, 46 (1943).—Manufacturers of porcelain enameled steel hot-water tanks at a meeting on April 22, 1943, adopted a commercial standard for their product. This will be known as Recommended Commercial Standard for Porcelain Enameled Tanks for Domestic Use, TS-3488. The standard will become effective 120 days after the final announcement by the National Bureau of Standards that the standard has been accepted. It covers enameled tanks in sizes of 15 to 80 gal., inclusive, for 300 lb. per sq. in. maximum hydrostatic test pressure, and it deals in detail with requirements, test methods, and methods of marking and labeling. L.E.T.

**Tin oxide as an opacifier of vitreous enamels.** ANON. *Tin and Its Uses*, No. 14, pp. 4–5 (May, 1943).—Tin oxide provides unsurpassed whiteness and opacity; it is usable with a wide range of frits and melting conditions, and it increases the physical strength and etching resistance of the enamel. Tin oxide is expensive, however, and an effort has been made to make it go further by studying the particle size of the various grades; the finest grade had 80% of the particles smaller than 0.5 micron, and the coarsest grade had only 15% smaller than 0.5 micron. Less tin oxide of the finer grades is needed, but makers of good-quality enamelware generally prefer the coarser. W.D.F.

**WPB orders more stoves.** ANON. *Enamelist*, **20** [11] 5–10 (1943).—The War Production Board authorized the manufacture of more stoves in General Limitation Order No. L-23-c as amended July 29, 1943. As nearly as can be estimated, the production program set up in Schedule "A" of this order will permit the manufacture of 4,000,000 to 4,500,000 stoves or approximately half of the industry's unit production in the base period. The complete text of order No. L-23-c is given. L.E.T.

SEPARATE PUBLICATION

**Porcelain Enamel, the Lifetime Finish.** Published by the American Rolling Mill Co., Middletown, Ohio, 1943. Free.—Useful data for product engineers, designers, architects, and others interested in the use of porcelain enameled iron are presented. Engineering information is given on resistance to abrasion and friction, weather, chipping, and thermal shock; color fastness and range; finishes available; and the chemical resistance and physical properties of porcelain enamel. Its physical properties are compared with those of many other materials: glass, whiteware, thermosetting plastics, hard rubber, aluminum and its alloys, nickel, copper, zinc, iron alloys, and cast iron. Drawings show several of the "do's" and "don'ts" of designing products that are to be porcelain enameled. The importance of a highly refined sheet iron with special surface characteristics and physical properties best suited for porcelain enameling is discussed. A brief explanation of the methods of making porcelain enamel and a bird's-eye view of the porcelain enameling industry and its production facilities should be interesting to many new users of porcelain enameled iron in postwar development.

PATENTS

**Enameled tank.** C. E. MURPHY (Porcelain Steels, Inc.). U. S. 2,330,306, Sept. 28, 1943 (Nov. 25, 1940).

**Improvements in or relating to glass coatings.** WESTINGHOUSE ELECTRIC INTERNATIONAL CO. Brit. 546,357, July 22, 1942 (March 16, 1940); *Enamelling Abs.*—Use is made of the property of certain glasses of being soluble in polyhydric alcohols. Porous materials such as asbestos can be treated with such a solution, the solvent can be evaporated off, and the glass can be fused, being thus distributed throughout the material. F.J.H.

**Procedure for making dull white enamels.** DEUTSCHE GOLD- UND SILBER-SCHEIDEANSTALT VORM. ROESSLER. Belg. 438,352, April, 1940; addition to Belg. 434,586 (*Ceram. Abs.*, **22** [10] 169 (1943)).—Substances generating gas (unsaturated, nongaseous, organic compounds, such as vinylates and acrylates or their polymerization products) are incorporated in the mix. M.Ho.

**White opacifier for enamels.** DEUTSCHE GOLD- UND SILBER-SCHEIDEANSTALT VORM. ROESSLER. Belg. 438,416, April, 1940.—The opacifying agent consists essentially of $CeO_2$ and alkalized clay. M.Ho.

## Glass

**Chemistry and physical chemistry of glass.** ARTHUR S. WATTS. Presented at meeting of the Ohio Section of the American Physical Society, Columbus, Ohio, Nov., 1942; abstracted in *Ohio State Univ. Eng. Expt. Sta. News*, **15** [2] 3 (1943).

**Cutting wide-bore glass tubing and glass bottles.** A. G. LIPSCOMB. *Chem. & Ind.*, **62** [32] 303 (1943).—L. describes a method of cutting glass tubing or bottles that requires only a piece of string and a beaker of cold water. The glass or bottle is held on a table so that the cutting point is just over the end of the table. The piece of string is looped once around the tubing or bottle, and the free ends are held below the table. With a fair tension, the string loop is rotated vigorously by pulling the ends of the string alternately. This heats up the glass, and care must be taken to keep the pull in one plane so that the glass is heated up along a line no wider than the diameter of the string. When the glass is hot enough (this may be judged by a smell of scorching string or by smoke from the string), the string is pulled off and water is immediately poured on the tubing at the hot spot. A clean cut all around the tubing or bottle results. See *Ceram. Abs.*, **22** [10] 169 (1943). R.H.B.

**Evolution of the electric lamp.** J. N. ALDINGTON. *Endeavour*, **2** [6] 62–67 (1943).—The history of electric lamps is concluded by reference to the recently introduced discharge lamps such as the sodium-vapor lamp and low (0.01 mm.), medium (0.5 to 5.0 atm.), and high pressure (5 to 100 atm.) mercury-vapor lamps. The first operates in conjunction with a fluorescent coating which glows visibly when irradiated by the mercury bands in the ultraviolet. The light from the medium- and high-pressure lamps is emitted by the mercury vapor itself which emits approximately like an incandescent body, the more nearly so the higher the pressure, when above its boiling point. This has called for borosilicate- and quartz-glass bulbs. The thermal expansion of the former glass was matched to that of tungsten or molybdenum so that seals would operate up to 500°C. A satisfactory seal through quartz glass has also recently been developed. 9 figures. L.R.B.

**Evolution of lens-grinding methods.** W. G. KETT. *Australasian Jour. Optometry*, June 30, 1941; reprinted in *Optician*, **102** [2634] 85–86 (1941).—Modern lens-grinding methods have evolved from the older practices of the lapidary and the potter. A.P.

***Examination of large polished glass areas.** E. GELBKE. *Zeiss Nachr.*, **4** [4] 89–91 (1941); abstracted in *Physik. Ber.*, **23** [6] 763 (1942).—A method which uses the Zeiss Epi-Condenser W is described. M.Ha.

**Glass Research Institute.** ANON. *Bull. Amer. Ceram. Soc.*, **22** [10] 357 (1943).

**Glassmaking raw materials of the neighborhood of Jammu (Jammu and Kashmir State).** H. L. CHHIBBER AND M. L. MISRA. *Trans. Indian Ceram. Soc.*, **2** [1] 47–60 (1943).

* Obtained from microfilm.

**Home of tomorrow.** AMORY HOUGHTON. *Amer. Glass Rev.*, **62** [44] 12 (1943).—In a radio talk H. stated that glass will be used in postwar home building for construction, decoration, and equipment. A.P.

***Measurement of the adsorption of hydrogen on glass.** W. H. KEESOM AND J. SCHWEERS. *Physica*, **8** [9] 1007–19 (1941); abstracted in *Physik. Ber.*, **23** [5] 596 (1942).—The adsorbed amount ($X$) of H on glass at 14° to 20° abs. can be represented by the equation $\log (X/p) = 226.54/T - \log T - 15.328 - (5.8050/T - 0.1108) \times X \times 10^{10}$, where $p$ = pressure in microbars, and $X$ = the adsorbed amount in mol. per cm.$^2$. The adsorption energy is independent of temperature between 14° and 20° abs. M.HA.

***Measurements of the adsorption of helium and of neon on glass.** W. H. KEESOM AND J. SCHWEERS. *Physica*, **8** [9] 1020–31 (1941); abstracted in *Physik. Ber.*, **23** [5] 596 (1942).—Measurements of Ne were made between 11° and 20° abs. and of He between 1° and 9° abs. The adsorption energies are independent of temperature but depend largely on the condition of charge. M.HA.

**New standard on glass-bonded mica radio insulators.** ANON. *Ind. Standardization*, **14** [8] 239 (1943).—This American War Standard deals with performance requirements, test methods, and design practice. It differs from other standards in that no standard shapes are set up. Instead, only the procedure for handling and machining these insulators is indicated. W.D.F.

**New uses for glass.** W. E. S. TURNER. *Jour. Roy. Soc. Arts*, **91** [4636] 224–35 (April 2, 1943).—During the past 15 years glass technology has become established as a new applied science. T. distinguishes briefly several aspects of the great advance: (1) systematic correlation between the chemical composition and the physical properties of 17 different kinds of glass; (2) the study of refractories and the development of high-temperature processes; (3) the invention of new machinery and methods of converting glass into a vast number of articles of different shapes and sizes; and (4) the study of methods of treating glass surfaces and the combining of glass with other substances, e.g., metals, ceramic materials, and plastics. Great advances are shown in the understanding and the technique of sealing glass to ceramic materials and metals; the incorporation of wire, foil, or layers obtained by spray or in the form of thick electrodes, makes possible the construction of metal filament electric lamps, cathode-ray tubes for television, and radio tubes of many sizes and types. 10 illustrations. K.R.

**Frank O'Neill, pioneer glassworking machinery builder.** ANON. *Nat. Glass Budget*, **59** [19] a–d (1943).—Frank O'Neill has devoted his entire business life to providing the manufacturers of glass products with glassworking equipment that would speed up the production of glass containers, reduce the cost, make better ware, and aid in eliminating the diversified perplexities that generally prevailed in hand-operated factories. His achievements in the manufacture and development of glass bottle blowing machines are discussed. His first models over half a century ago led to the development of mechanical means for manufacturing glass containers. He has gained further prominence through the development of the O'Neill feeder, a mechanical device which successfully transfers the molten glass from the tank to the molds on the glass-blowing machines. The achievements of Mr. O'Neill are traced from the time when he first started as a mold maker, at the age of 15, up to the present. The O'Neill European Machine Co., Ville LaSalle, Montreal, Canada, is still serving the glass industry. H.E.S.

**Petrographic (polarizing) microscope in the investigation of glass.** W. J. MCCAUGHEY. Presented at meeting of the Ohio Section of the American Physical Society, Columbus, Ohio, Nov., 1942; abstracted in *Ohio State Univ. Eng. Expt. Sta. News*, **15** [2] 5–6 (1943).

**Phosphorescent glasses. Decay of phosphorescence.** MAURICE CURIE. *Trans. Faraday Soc.*, **35** [213] 114–18 (1939); abstracted in *Physik. Ber.*, **20** [16] 1768 (1939).—A Zn borate glass ($2B_2O_3 \cdot 3ZnO$), made under definite conditions with some Mn, has, in the vitreous state, a feeble reddish luminescence and, in the crystalline state (which can be obtained by heating for 1 hr. at 800°C.), a greenish-yellow phosphorescence. Ordinary glass, the crystallization of which is accelerated by adding 1% $CaF_2$ and heating for 4 days at 800°, behaves similarly. Curves of the vanishing intensity were derived from observations between 10 and 4000 sec. of time of luminescence. See *Ceram. Abs.*, **16** [7] 202 (1937). M.HA.

**Physical procedures used in ceramic research.** GEORGE A. BOLE. Presented at meeting of the Ohio Section of the American Physical Society, Columbus, Ohio, Nov., 1942; abstracted in *Ohio State Univ. Eng. Expt. Sta. News*, **15** [2] 3–5 (1943).

**Physical treatment of glasses.** HENRY H. BLAU. Presented at meeting of the Ohio Section of the American Physical Society, Columbus, Ohio, Nov., 1942; abstracted in *Ohio State Univ. Eng. Expt. Sta. News*, **15** [2] 6–7 (1943).

**Proper care will prolong the life of chemical glassware.** EVAN J. LEWIS. *Chem. & Eng. News*, **21** [8] 552–54 (1943).—Longer service will be obtained from chemical glassware if the following rules are observed: (1) Use the article for the service for which it was designed. (2) Do not heat the glass beyond its strain point or maximum temperature limit as defined by the manufacturer. (3) Never use an unprotected stirring rod. (4) Use a large soft flame and not a sharp hot one in heating operations. (5) Avoid severe local heating. (6) Avoid abrupt temperature changes, particularly unnecessarily rapid cooling. Illustrated. F.G.H.

**Recent development of glass tanks important advancement in industry.** ANON. *Amer. Glass Rev.*, **62** [44] 8 (1943).—Tanks or vats built of glass are readily installed in new or existing units. They are strong, permanent, and resistant to quick temperature changes because the glass is tempered. They can be fashioned in many shapes and sizes, are impervious to chemicals and liquids of almost any type, do not rot, and are nonabsorptive and sanitary. Standard glass tanks are built by the Pittsburgh Plate Glass Co. of opaque Carrara structural glass or of clear plate glass and are completed at the glass factory or installed by special crews for relining tanks previously utilizing copper, rubber, or other critical materials. A.P.

***Relation between the surface tension and the structure of molten glass.** A. DIETZEL. *Kolloid-Z.*, **100**, 368–80 (1942).—A theoretical discussion of conditions found on the surface of a molten glass, glaze, or enamel is presented. D. starts by analyzing the surface of a molten crystal. On such a surface the degree of incompleteness ($f$) is independent of the coordination number and equals 0.20. D. defines the degree of incompleteness (*Grad der Unvollständigkeit*) as the ratio of missing attached atoms to the total number of attached atoms when the coordination is complete. Thus, for a coordination number 6, mostly only one partner is missing or $f = 0.17$. At times two are missing; then $f = 0.33$. For a coordination number 8 mostly two are missing, $f = 0.25$, but sometimes only one is missing and $f = 0.13$. Generally, the value of $f$ decreases with an increasing affinity between the anions and cations. An attempt is made to evolve a simple relationship between the surface tension and the known data on crystal chemistry. This can be done only for salts of the same anion. Here there is a linear relationship between $\sigma$ and the forces of attraction or, in the case of alkali salts, the cationic radii. The curves vary for different ions, which points to the fact that the polarizability of the anions has a perceptible effect on the surface tension. Because of the complexity of glass it is more convenient to use the molar effectiveness factor ($F$) of the oxides in place of the cationic radii ($r$). Thus, $\sigma = p_1F_1 + p_2F_2 + \ldots$, where $\sigma$ is surface tension, $p$ is mole % of the oxide in the mix, and $F$ is the molar effectiveness factor. $F\sigma$ for a number of cations was computed from available data and plotted against $r/z$, where $r$ is the radius and $z$ the valence. The curve had two branches;

* Obtained from microfilm.

on one were found cations which may combine to form complex anions, viz., Zr, Si, Al, Ti, and B. On the other branch were Na, K, Li, Ca, Ba, Zn, etc. The values of $F\sigma$ for the anion-forming cations are generally smaller than would be expected from the values of $r/z$. D. explains this by the fact that complex anions have a relatively large diameter and therefore affect the surface tension only slightly. The branch carrying the true cations has a break if the $F\sigma$ values for Na and K plotted on it are calculated from glasses of the usual composition. This break disappears if the $F\sigma$ values for Na and K are computed from the respective metasilicates or metaborates. PbO and $V_2O_5$ had negative values for their respective $F\sigma$. This is attributed to the fact that Pb and the vanadate ions are readily deformed; they accumulate at the surface and cause a lowering of the surface tension. It can be seen from energy relationships that B in a molten glass surface has a coordination number 3. This is also supported by the normal behavior of B. At no time does B show any anomalies, and its presence always lowers the surface tension in proportion to the amount of it in the mix. Replacing O by other anions such as $S^{--}$, $F^-$, or $OH^-$ lowers the surface tension, because the energy of attraction between the cations and anions is lower. This is particularly pronounced in the case of sulfide. Like the easily polarized cations, the sulfides collect on the surface. The relation between the coefficient of expansion ($a$) and $\sigma$ or $d\sigma/dt$ as proposed by Cantor and Ramsay and Shields for unassociated liquids was tested on molten glass. The relation between $\sigma$ and $a$ is in fairly good agreement in spite of the fact that the assumption of the state of association does not apply in this case. The relation between $a$ and $d\sigma/dt$ shows considerable deviation, possibly because the relation between $\sigma$ and $t$ (temperature) for glass has not been thoroughly investigated. M.Ho.

**$6000 saved by reducing tank cooling wind.** ANON. *Ceram. Ind.*, **41** [2] 51–53 (1943).—The necessity of cooling glass tanks and savings resulting from proper use of the cooling air are discussed. H.T.

**Tin in glass manufacture.** ANON. *Tin and Its Uses*, No. 9, p. 12 (May, 1941).—Stannic oxide is one of the best opacifiers and for centuries was the only one known. Fluorides are a substitute, but they erode the melting pot more rapidly. Stannous chloride is used in ruby glasses which derive their color from colloidal gold or copper. An iridescent rainbow effect is obtained when the glass is exposed to the vapor of stannic chloride. Stannic oxide is also used as "putty powder," an abrasive for polishing rough surfaces in cut glass. W.D.F.

**Two-zone furnace heats glass-wool batts for pressing operations.** ANON. *Ind. Heating*, **10** [8] 1140–42 (1943).—Glass plates used in humidifiers for warm air heating systems are formed by pressing glass-wool batts between expanded metal forms after heating in a two-chamber furnace. In the first zone, at 1350°F., a sintering action takes place, and the fibers of glass wool become a coherent yet sufficiently porous mass; in the second zone, at about 1200°F., an annealing action takes place which minimizes breakage of the plates during and after pressing. The whole process and equipment of the Skuttle Mfg. Co. is described in detail. M.Ha.

**Use of fibrous glass by the Army and Navy.** HUBERT D. KEISER. *Amer. Inst. Mining & Met. Engrs. Tech. Pub.*, No. 1598; *Mining Tech.*, **7** [3] 14 pp. (1943).—K. first reviews methods of production, types of glass used, and kinds of manufactured products. General military uses comprise (1) insulation in all kinds of electric equipment, (2) thermal insulation in trucks and retainer mats in storage batteries, (3) thermal insulation in buildings and tents used in cold weather, (4) sound absorption in sound stacks for motor-test chambers, (5) thermal insulation in refrigerators and cold-storage rooms, (6) medical uses, such as plasma filter, sutures, etc. Army applications include (1) tension core and insulation for telephone cable, (2) parachute flare shields, and (3) camouflage. Navy uses include (1) insulating board for use in the compartments of ships, (2) sound-absorbing blankets, and (3) curtains to replace doors. Many industrial applications are helping to increase output; in alcohol rectification, glass-fiber filters are replacing Raschig rings. The fiber is cheaper, and in one case output of existing equipment was trebled. W.D.F.

**Welding-glass warning.** ANON. *Chem. Age* [London], **48** [1229] 92 (1943).—Welders' blue glass gives practically no protection against the real hazards of welding. A welding glass must serve two purposes: it must reduce glare to enable a man to see his job clearly, and it must absorb the potentially harmful infrared and ultraviolet rays. Welders' blue cuts the glare down but transmits 43% infrared and 80% ultraviolet. B.S.S. 679 welders' glass (supplied in five shades) should be used for all types of welding if trouble with the eyes is to be avoided. It is green in tint, cool, pleasant in use, and gives good definition. A glass suitable for welders' mates is practically colorless but will give protection where the worker is exposed to indirect flash. It is especially good for light spotwelding and where a large amount of heat is radiated, such as at gas and electric furnaces or retorts; it transmits only 18.2% infrared and no ultraviolet. The maker's name is obtainable from the Information Bureau, Royal Society for the Prevention of Accidents, 52 Grosvenor Gardens, London, S. W. 1, England. See *Ceram. Abs.*, **22** [10] 172 (1943). A.B.S.

SEPARATE PUBLICATION

**Effect of Fluorspar on Silicate Melts with Special Reference to Mineral Wool.** J. S. MACHIN AND J. F. VANECEK. *Illinois State Geol. Survey Rept. Investigations*, No. 68, 15 pp. (1940).—Tabulated and graphic results are given of tests to determine the relationship between the fiber diameter of rock wool and the fluorspar content of the melt. A theoretical discussion of the action of fluorspar in silicate melts is included.

PATENTS

**Apparatus for drawing sheet glass.** COMPAGNIE INTERNATIONALE POUR LA FABRICATION MÉCHANIQUE DU VERRE (PROCÉDÉS LIBBEY-OWENS) SOC. ANON. Belg. 438,351, April, 1940. M.Ho.

**Apparatus for fining molten glass.** J. G. FRANTZ (Pittsburgh Plate Glass Co.). U. S. 2,330,343, Sept. 28, 1943 (March 12, 1942).

**Apparatus and method whereby improved mineral wool fibers and products may be made.** D. C. DRILL AND C. C. DAVIS (American Rock Wool Corp.). U. S. 2,328,714, Sept. 7, 1943 (March 19, 1941).

**Apparatus for treating glass sheets, etc.** J. A. MCCORMICK, JR. (Dearborn Glass Co.). U. S. 2,329,922, Sept. 21, 1943 (Oct. 25, 1940).

**Apparatus for use in the shaping of glass sheets or plates.** A. MCK. GREAVES-WALKER (Libbey-Owens-Ford Glass Co.). U. S. 2,330,279, Sept. 28, 1943 (March 27, 1940).

**Automatic feeding of a glassmelting furnace for producing glass thread and glass fibers.** ALGEMEENE KUNSTVEZEL MIJ. N. V. Belg. 438,579, May, 1940.—Sheets of glass are conveyed into the furnace so that their lower edge rests on traverses at a certain distance from the level of the bath. M.Ho.

**Bottle-forming machine.** J. M. YOUNG (Gertrude Young, administratrix). U. S. 2,328,873, Sept. 7, 1943 (July 24, 1939).

**Coating glass.** C. P. MARSDEN, JR. U. S. 2,329,632, Sept. 14, 1943 (Dec. 19, 1938).—A method of coating the interior walls of incandescent light bulbs.

**Felting fibrous glass.** GAMES SLAYTER (Owens-Corning Fiberglas Corp.). U. S. 2,331,145, Oct. 5, 1943 (Jan. 6, 1940).

**Felting glass fibers.** GAMES SLAYTER (Owens-Corning Fiberglas Corp.). U. S. 2,331,146, Oct. 5, 1943 (Jan. 6, 1940); divided out of U. S. 2,206,059, July 2, 1940 (Dec. 24, 1936).

**Fining of glass.** F. W. ADAMS (Pittsburgh Plate Glass Co.). U. S. 2,330,324, Sept. 28, 1943 (Feb. 25, 1942).

**Fire-polishing apparatus.** J. P. BROWN (Owens-Illinois Glass Co.). U. S. 2,331,014, Oct. 5, 1943 (June 20, 1940).

**Glass-bending apparatus.** H. J. GALEY (Pittsburgh Plate Glass Co.). U. S. 2,330,349, Sept. 28, 1943 (Sept. 6, 1940).

**Glassmelting furnace.** L. S. LONGENECKER. U. S. 2,328,917, Sept. 7, 1943 (June 29, 1940).

**Improved apparatus for grinding, abrading, and polishing glass, etc.** ÉTABLISSEMENTS SERVIN & MIGEOT, SOC. ANON. Belg. 428,516, July 30, 1938; addition to Belg. 419,717, Jan. 29, 1937.—The sheets of glass are stood on their edges on the grinding table spaced at definite distances in such manner that each sheet fits into a groove. Spacers are wedged between the sheets in at least three points not in the immediate vicinity of the borders. M.Ho.

**Improved apparatus for polishing glass.** PILKINGTON BROS., LTD. Belg. 440,396, Feb., 1941.—An equal and opposite pressure is applied to both sides of the glass. The bodies pressing onto the glass are given a circular motion, while the glass travels in a plane perpendicular to the pressure exerted on it. The elements of each pair (one on either side of the glass) of the polishing device turn in the same direction, whereas two adjacent devices turn in opposite directions to each other. M.Ho.

**Insulator plunger support.** C. B. SHILLINGER (Owens-Illinois Glass Co.). U. S. 2,331,053, Oct. 5, 1943 (Feb. 21, 1942).

**Laminated safety glass.** J. D. RYAN AND G. B. WATKINS (Libbey-Owens-Ford Glass Co.). U. S. 2,330,313, Sept. 28, 1943 (Aug. 7, 1940).

**Lehr.** D. G. MERRILL (Hartford-Empire Co.). U. S. 2,330,984, Oct. 5, 1943 (Feb. 12, 1941).

**Making glass banks.** ANTHONY KAZISKA (Pittsburgh Corning Corp.). U. S. 2,330,363, Sept. 28, 1943 (Dec. 14, 1938; May 25, 1940).

**Making pressed hollow glassware.** LOUIS POGLEIN (McKee Glass Co.). U. S. 2,329,136, Sept. 7, 1943 (Nov. 18, 1941).

**Making stained glass articles.** H. H. BLAU (Corning Glass Works). U. S. 2,330,193, Sept. 28, 1943 (Feb. 7, 1941).

**Manufacture of hollow glass articles.** H. F. TEICHMANN. U. S. 2,329,146, Sept. 7, 1943 (May 29, 1941).

**Method and apparatus for manufacturing glassware.** F. W. STEWART, M. J. KELLY, AND A. J. REEK (Kelly Foundry & Machine Co.). U. S. 2,329,012, Sept. 7, 1943 (May 1, 1940).—In a paste mold glass machine, a support, a blow head that moves in a circle about the support, the blow head having a hollow rod therein for cooperation with a blowpipe.

**Photographic glass tile.** B. A. BOLLINGER (Beverly Williams and Russell Baker). U. S. 2,329,384, Sept. 14, 1943 (May 3, 1941).

**Refining molten glass.** H. A. SHADDUCK (Owens-Illinois Glass Co.). U. S. 2,331,052, Oct. 5, 1943 (Nov. 27, 1941).

**Reflecting optical system.** H. H. BLAU (Corning Glass Works). U. S. 2,330,194, Sept. 28, 1943 (June 10, 1941).

**Safety mechanism for glassforming machines.** C. M. BIGGS (Hazel-Atlas Glass Co.). U. S. 2,330,668, Sept. 28, 1943 (Sept. 13, 1939).

**Seal and method of manufacture.** GEORGE MEISTER (Westinghouse Electric & Mfg. Co.). U. S. 2,330,072, Sept. 21, 1943 (May 14, 1941).—(1) A seal comprising completely degasified hard glass fused directly to silica. (8) The method of connecting vitreous materials, comprising merely heating hard glass to about 1700°C., until evolution of gas ceases, and then sealing it directly to quartz. (14) A seal in which wire passes through a completely degasified glass, producing a gastight connection.

**Surface-treating glass containers.** B. A. NOBLE (Owens-Illinois Pacific Coast Co.). U. S. 2,331,041, Oct. 5, 1943 (June 19, 1940).

**Tempered hollow glass article.** H. R. KIEHL (Corning Glass Works). U. S. 2,329,057, Sept. 7, 1943 (Jan. 29, 1941).

## Structural Clay Products

SEPARATE PUBLICATION

**Mortar Bond Characteristics of Virginia Brick: I, Flow Table Calibration Tests.** JOHN W. WHITTEMORE AND PAUL S. DEAR. *Bull. Virginia Polytech. Inst., Eng. Expt. Sta. Series*, No. 54, pp. 5–8 (May, 1943). Price 25¢.—The tests described were conducted with the flow table in the masonry laboratory of the Ceramic Engineering Department of the Virginia Polytechnic Institute to compare the standard flow tables in use at the several cooperating laboratories. All tests were made on a standard mortar compounded from standard materials. Testing procedures were standardized as completely as possible so that the only variables for the comparison would be (1) the flow tables and (2) the operators. **II, Properties and Characteristics of Tension-Bond Strength Between Mortar and Brick.** *Ibid.*, pp. 8–47.—The tests described were performed to determine the effect of brick texture upon the tension-bond strength and other characteristics of mortar bond. This effect was determined for (1) various kinds of brick, (2) various suction rates of these brick, and (3) various flows or mortar consistencies of the lime-putty mortar. This portion of the report is summarized in the following outline (kind of variable and number in program): kind of brick, 4; suction rate, 4; sand grading, medium; mortar mix, 1; mortar flow, 3; joint thickness, $\frac{1}{2}$ in.; type of test, tension-bond; specimens per point, 10; auxiliary tests, tension, compression, and retentivity tests on mortars and absorption, compression, and flexure tests on brick; total number of bond specimens, 480.

PATENTS

**Universal structural block.** A. GODITIABOIS. Belg. 438,489, April, 1940.—The block is built in such manner that its center of gravity and center of symmetry coincide. Each of the lateral faces of the block have a protruding and a concave part corresponding to it. **Belg. 440,185,** Jan., 1941; addition to Belg. 438,489.—Two opposite faces of a quadrangular prism are plane; the two other faces have a protruding and a concave part corresponding to each other so that the center of symmetry of the block coincides with its center of gravity. M.Ho.

## Refractories

**Complete calculations of heat exchange in regenerators.** H. HAUSEN. *Z. Ver. Deut. Ing., Beihefte Verfahrenstech.*, **1942,** No. 2, pp. 31–43; abstracted in *Fuel Research Intelligence Section, Summary for Two Weeks Ending Dec. 19 and 26, 1942*, p. 676; *Woodall-Duckham Tech. Press Rev.*, No. 890, p. 5 (Jan. 20, 1943).—The theory of heat exchange developed mainly for earthenware regenerators is extended to cover rapid temperature changes and variable temperatures at the ends of the regenerators. The equations and diagrams developed enable exact calculations to be made for regenerators even under unusual conditions and are applicable also to limiting cases of thick or thin brick.

**Deterioration of blast-furnace linings by the action of carbon monoxide.** D. SWARUP AND R. P. SATARAVALA. *Trans. Indian Ceram. Soc.*, **2** [1] 15–31 (1943).—Carbon monoxide of the blast-furnace gas penetrates into the brickwork and dissociates as follows: $2CO \rightarrow CO_2 + C$. The carbon deposited in the brickwork as a result of the above dissociation often damages the refractory linings of iron blast furnaces. The reaction occurs mostly between 350° and 600°C. and is greatly influenced by the nature and the amount of the ferruginous content of the firebrick. Experiments carried out on a pure grade of fire clay incorporated with different forms of ferruginous material

are described; different grog-fire clay mixtures were tried, and the effect of small additions of copper sulfate was studied. Brick free from ferruginous material withstood the test best. Among the brick incorporated with ferruginous impurities (which were added on a 3% $Fe_2O_3$ basis), highly grogged brick (75% grog content) and brick having its ferruginous content in the form of a silicate of iron were more resistant to this type of disintegration. Copper sulfate retarded the initial discoloration which preceded the deposition of carbon.

**Measurement of the thermal conductivity of fire-clay refractories.** T. C. PATTON AND C. L. NORTON, JR. *Jour. Amer. Ceram. Soc.*, **26** [10] 350–58 (1943).—3 references, 14 figures.

**Modern foundry work.** R. J. RICHARDSON. *Proc. S. Wales Inst. Engrs.*, **58** [3] 131–80 (1942).—The routine testing of molding sands for permeability, strength, moisture content, and refractoriness is described. For molding sands, Belgian sand containing its own bond has been replaced by weaker sands strengthened by bentonite or English ball clays. Such changes were easily and quickly effected where the characteristics of the usual sand were well understood. Silica sand bonded with dextrin or molasses is used for cores, which are cellulated for easy collapsing by adding coke or sawdust. L.R.B.

**Rapid method of assessing the resistance of refractory materials to disintegration by carbon monoxide.** F. H. CLEWS, H. M. RICHARDSON, N. E. DOBBINS, AND G. R. RIGBY. Reprinted in *Trans. Brit. Ceram. Soc.*, **42** [6] 105–10 (1943); see *Ceram. Abs.*, **21** [1] 15 (1942). R.A.H.

**Recent progress in the manufacture of metallurgical refractories.** Y. LETORT. *Rev. Mét.*, **1942,** May, pp. 141–51; June, pp. 172–80; abstracted in *Iron & Coal Trades Rev.*, **146,** 351 (March 5, 1943); *Woodall-Duckham Tech. Press Rev.*, No. 897, p. 3 (March 10, 1943).

***Refractoria Quo Vadis?*** J. D. SULLIVAN. *Blast Furnace & Steel Plant*, **30,** 72–75 (Jan., 1942); abstracted in *Woodall-Duckham Tech. Press Rev.*, No. 858, p. 5 (April 22, 1942).—S. reviews recent trends and developments in the manufacture of refractories, particularly those of the last year.

**Refractories for lime-recovery kilns.** BRASHARES. *Paper Ind. and Paper World*, **1942,** 1200–1203; abstracted in *Refrac. Jour.*, **18** [11] 315 (1942).—A comprehensive study has been made of the properties of refractory liners suitable for use at the feed, intermediate, and burning zones of a rotary kiln operating on pulp mill lime sludge. Many practical problems are discussed in detail.

**Refractories with OPA.** ANON. *Bull. Amer. Ceram. Soc.*, **22** [10] 358 (1943).

**Refractory materials for glassmaking.** J. H. PARTRIDGE. *G.E.C. Jour.*, **12** [3] 119–31 (1943).—The nature of glass is explained by reference to its historical development. A table of analyses of modern glasses and Egyptian glass is given. Glass articles were first formed by a building-up process, but glass blowing replaced this method just before the Christian Era. From Venice, in the 16th century, the art of glassmaking spread to England and elsewhere. The processes used at that time are described. The advent of machinery for manipulating glass in the 19th century called for greater masses of glass of more finely controlled characteristics, and the tank furnace evolved. A close control of temperature and output in the tank furnace is necessary because (1) the viscosity of glass changes rapidly with temperature, (2) the volatilization rate of alkali varies and gives rise to streams of glass of different composition (streaking or cording of glass), and (3) fluctuations of output also result in cordiness. Dissolution of the refractory lining also impairs the quality of the glass. The mineralogical constitution, determined by X rays, of a number of fire-clay and sillimanite tank blocks is discussed in the light of their durability. A good tank block should be fired to 1400°C., when well developed mullite crystals are formed. Tests of texture, porosity, and constitution are supplemented by a corrosion test, which, in P.'s method, consists in founding glass under specified conditions in a small crucible made by boring a hole in a suitable specimen of the refractory under test. The increase in the alumina content of the glass is taken as a measure of the resistance to corrosion. Some blocks of low porosity and close texture are not resistant to corrosion because the glassy matrix is more soluble (or fusible) than usual. This is detected by long-period tensile tests at 1350° or 1400°C. under a stress of 500 gm. per sq. cm. The rate of extension is a measure of the fluidity of the intercrystalline cement. The tuck-stones sealing the gap between the roof and walls of the glass tank are attacked by batch dust. They decompose on the face into $\alpha$-alumina and siliceous liquid, a reaction which occurs only at 1810°C. in pure materials but at 1470° to 1500°C. in the presence of the batch dust and impurities in the clay. As a result of tensile and corrosion tests, it has been found that siliceous materials are less corroded than normal 40% alumina material, and the former have now replaced the latter in service. 11 figures. L.R.B.

**Supervision of orders in the refractories industry.** W. VAN BERK. *Tonind.-Ztg.*, **65** [29] 277 (1941); abstracted in *Trans. Brit. Ceram. Soc.*, **41** [4] 52A (1942).—Five forms are illustrated which are to be filled by the supervisor of the order, who must have adequate knowledge of the material and of the manufacturing processes.

SEPARATE PUBLICATIONS

**Elements of Heat Transfer and Insulation.** MAX JACOB AND GEORGE A. HAWKINS. John Wiley & Sons, Inc., New York, 1942. 169 + xvi pp., 50 figs. Price $2.50. Reviewed in *Jour. Applied Physics*, **14** [4] 166–67 (1943). A.P.

**Heat Transmission Through Furnace Walls.** Published by Atlas Lumnite Cement Co., New York, 1943. 16 pp. Free.—Ten full-page charts simplify the solution of heat-transfer problems in connection with refractories and high-temperature insulation. Curves on the charts are plotted in terms of conductivity factors. The novel arrangement makes it possible to use the charts for firebrick, insulating brick, refractory concrete, plastic refractories, or any refractory material for which the conductivity ($k$ factor) is known. The industrial furnace designer can use the charts for the rapid determination of cold-face temperatures and heat losses. He can select the proper material, or combination of materials, and wall thickness to give a desired cold-face temperature or to minimize heat loss. Efficiencies of two or more designs of furnace wall or flue lining can readily be compared. The curves are calculated in accordance with A.S.T.M. Recommended Procedure for Calculating Heat Loss Through Furnace Walls. Information on the conductivity factors of some common refractory materials is given with remarks on the reliability of test data and their practical usefulness. Designers and operators of industrial furnaces, flues, stacks, and process heating equipment will find the booklet a timesaver.

**Manual of A.S.T.M. Standards on Refractory Materials.** Published by the American Society for Testing Materials, Philadelphia, 1943. 210 pp. Price, heavy paper cover, $1.50; cloth, $1.75. Reduced prices on quantities.—This latest compilation includes new standards for air-setting refractory mortars; fire-clay plastic refractories both for boiler and incinerator services; methods of test for measuring the shrinkage, spalling, and workability index of fire-clay plastic refractories; and a method for measuring the thermal conductivity of insulating firebrick. Seven specifications on refractories for various types of service are given. There are two classifications of materials, and the remaining sixteen standards give various methods of testing fire-clay refractory brick, fire-clay plastic refractories, insulating firebrick, and various types of refractory materials. The latter includes tests to determine P.C.E., permanent linear change, cold crushing strength, warpage, porosity, and true specific gravity. Ten industrial surveys of refractory service conditions cover open-hearth practice, electric furnaces used in steel manufacture, by-product coke ovens, stationary steam boilers, and the malleable iron, copper, lead, lime-burning, glass, and Portland

cement industries. The manual also gives standard samples of refractory materials for chemical analysis and for pyrometric cone equivalent.

PATENTS

**Ceramic cement.** W. K. CARTER (National Aluminate Corp.). U. S. 2,329,589, Sept. 14, 1943 (March 10, 1941).—Process of improving the physical properties of ceramic cements which comprises incorporating therewith during some stage of their manufacture before final hardening a substantially stable colloidal solution of silica, the solution being comparatively free from alkali-metal ions and electrolytes and having an $SiO_2$ to $Na_2O$ ratio of at least 10:1.

**Fillings for heat regenerators.** WOODALL-DUCKHAM (1920), LTD., AND A. N. CLARK. Brit. 543,688, March 18, 1942 (Dec. 21, 1940); abstracted in *Woodall-Duckham Tech. Press Rev.*, Abs. No. 426.—A block for filling heat regenerators for coke ovens, etc., and various ways of arranging such blocks in the regenerator chambers.

**Improved furnace walls and procedure for their construction.** M. H. DETRICK CO., LTD. Belg. 438,762, May, 1940.—A method of building furnace walls is described. M.Ho.

**Improved procedure for dissolving calcium aluminates in water and its use in the production of alumina.** J. C. SÉAILLES. Belg. 438,414, April, 1940.—The dissolving liquid contains a dilute alkali either free or as a salt. The dissolving liquid also contains a salt which inhibits the solubility of silica. M.Ho.

**Making refractories.** D. W. ROSS. U. S. 2,331,232, Oct. 5, 1943 (July 13, 1940).—The method of developing fire- and shock-resisting bond in silica-alumina refractories which comprises maintaining percentages of fluorine and $B_2O_3$ in the composition during desired parts of the firing period thereof, not over 5% of the $B_2O_3$ content remaining in the composition of the refractory on completion of the firing.

**Manufacture of refractory articles.** THERMAL SYNDICATE, LTD., AND G. N. PEEL. Brit. 554,955, Aug. 11, 1943 (March 30, 1942).

**Manufacturing sulfurous anhydride, alumina, and cements using sulfates of calcium.** J. C. SÉAILLES (vested in the Alien Property Custodian). U. S. 2,330,631, Sept. 28, 1943 (Nov. 21, 1939).

**Molded porous bodies.** DEUTSCHE GOLD- UND SILBER-SCHEIDEANSTALT VORM. ROESSLER. Belg. 440,213, Feb., 1941.—Substances which stabilize oxygen bubbles are added at the end of the preparation of the batch. Simultaneously, substances which in themselves produce or promote the evolution of oxygen are also added. M.Ho.

**Refractory material.** A. R. LUCAS AND W. G. WAGNER (P. B. Sillimanite Co., Ltd.). U. S. 2,330,129, Sept. 21, 1943 (Feb. 28, 1940).—The method of treating the surfaces of refractory bodies employed as furnace liners which comprises applying to the surfaces thereof, which would otherwise be exposed, a thin layer of finely divided refractory material adapted to yield a substantially nonporous refractory coating and thereafter applying to the surface of this layer a thicker coating of a composition containing refractory material in a coarser state of subdivision adapted after firing to yield a substantially porous outer layer.

**Structural element for suspended crowns or arches of hearths or furnaces.** VEITSCHER MAGNESITWERKE A.-G. Belg. 438,733, May, 1940. M.Ho.

**Vertical retorts or chambers.** STANDARD FURNACE & SETTING CO., LTD., A. W. H. PRIESTLEY, AND A. W. DIXON. Brit. 555,024, Aug. 11, 1943 (May 27, 1942).

## Terra Cotta

**Market for million stoves open to ceramic manufacturers.** ANON. *Ceram. Ind.*, **41** [2] 71–72 (1943); *Architectural Forum*, **78** [6] 54 (1943); *Science News Letter*, **44** [5] 75 (1943); *Brick & Clay Record*, **102** [5] 36 (1943).—Under the auspices of the Ohio State Research Foundation, war housing space heaters have been designed which are made of ceramic materials. Illustrated. See *Bull. Amer. Ceram. Soc.*, **22** [8] 300 (1943). H.T. & M.E.P.

**Salt and loam glazes for stoneware.** ANON. *Ziegelwelt*, **70,** 249–50 (1939); abstracted in *Chem. Zentr.*, **1939, II,** 3616–17.—As soon as the body begins to sinter, salt is added and an Na-Al silicate is formed with the $SiO_2$ of the body; hence, bodies rich in silica are preferable for salt glazes. In oil firing, high-pressure pulverization can be used. Salt glazes are best developed in closed furnace spaces. Loam glazes are recommended when the salt glaze is streaked and not uniform. It is important in this case that the refractoriness of the glaze lie below the temperature of the finish firing of the ware. The iron content of the glaze is between 4 and 8%, and the content of $TiO_2$, between 0.8 and 1%. To increase the latter, 2 to 3% finely ground rutile may be added. M.V.C.

PATENTS

**Lining ceramic objects with a coating resembling terra sigillata.** SCHÜTTE A.-G. FÜR TONINDUSTRIE. Belg. 440,393, Feb., 1941.—The dried ceramic object is lined with a colloidal suspension of clay. It is dried and then treated with a solution of a flux. The whole is again dried and fired. M.Ho.

**Roof shingles.** J. KNAPP. Belg. 438,502, April, 1940.—A description of the shingle is given. M.Ho.

## Whiteware

**Ceramic filter media.** JOSEF M. ROBITSCHEK. *Ceram. Age*, **42** [1] 8–11, 24–25 (1943).—High permeability, high porosity, and uniform distribution of pores are the properties required of media serving for filtration and gas diffusion. The manufacture of porous ceramic media is based on a simple principle which makes it possible to control these properties closely and to vary simultaneously the number, size, and shape of the pores. To a degree which has not been attained with other industrially used materials, porous ceramic filters permit the control of speed and efficiency of filtration and diffusion. Adaptability to use in different apparatus, possibility of production in various sizes and shapes, satisfactory mechanical strength, and practically absolute resistance to the chemical action of filtered or diffused liquids or gases are the main requirements for porous media used by the chemical and allied industries. Porous ceramic media fulfill all of the essential requirements, and this is the reason for their growing importance and expanding use. Illustrated. F.G.H.

**Ceramic insulation materials for high-tension and communication technique.** W. WEICKER. *Elektrotech. Z.*, **63,** 17–18, 207–10 (1942).—Porcelain has established its usefulness for scores of years because of its high electrical and mechanical strength, its resistance to high temperature, and its permanency. Recent improvements lie in the field of greater accuracy and closer dimensions formerly believed impossible for ceramics. Pieces are usually first bisque fired to 800°C., machined and ground to exact dimensions, and then refired to vitrification. This method is now extensively used in high-frequency ceramics. Complicated designs are produced by the glazing together of parts previously ground to finished dimensions (low-fire glazes are used in this process). Ceramic metallizing processes have been perfected, whereby fired pieces are covered with noble metals (Ag, Pt, etc.) suspended in rosin or essential oils and the ceramic parts are then heated in muffle furnaces to 800° to 850°C. Galvanic reinforcements of such metallized sections with copper are provided. 2 illustrations. L.E.T.

**Hard-porcelain plant.** J. WALLICH. *Oel & Kohle*, April 15, 1942; abstracted in *Chem. Trade Jour.*, **112** [2916] 349 (1943).—Modern German hard porcelain, made according to specification DIN 40/685, is being increasingly used in the fabrication of chemical and oil-refining equipment, where it replaces metal. By refined grinding, a dimensional accuracy of ± 0.01 mm. is possible. Pipes, valves, pumps, tongued and grooved lining tile, distillation vessels, rectifying columns, and filling rings are among its uses. The material has the following properties: Tensile strength, glazed, 300 to 500; unglazed, 250 to 350 kgm. per sq. cm. Resistance to compression, glazed, 4500 to 5500; unglazed, 4000 to 4500 kgm. per sq. cm. Bending strength, glazed, 900 to 1000; unglazed, 500 to 700 kgm. per sq. cm. Resistance to shock, unglazed, 1.8 to 2.2 cm. kgm. per sq. cm. Modulus of elasticity, 7000 to 8000 kgm. per sq. cm. Hardness (Mohs' scale), 7 to 8; resistance to abrasion, 0.09 to 0.14 cm.$^3$ per sq. cm. Density, 2.4 kgm. per cu. dm. Water absorption, nil. Resistant to all acids, except HF, at ordinary temperatures and to all alkalis. Specific heat, between 20° and 100°C., 0.19 to 0.21. See *Ceram. Abs.*, **20** [10] 240 (1941). L.R.B.

**Physical chemistry of firing steatite ceramics.** R. L. STONE. *Jour. Amer. Ceram. Soc.*, **26** [10] 333–36 (1943).—3 references, 3 figures.

**Physical testing of talc for high-frequency ceramics.** SIDNEY SPEIL. *Jour. Amer. Ceram. Soc.*, **26** [10] 336–38 (1943).—6 references, 1 figure.

PATENTS

**Ceramic insulator and method of making.** R. D. BÜGEL (Hartford National Bank and Trust Co.). U. S. 2,330,950, Oct. 5, 1943 (Feb. 28, 1940).—As a material for making a ceramic insulator, titanium dioxide containing not more than 1% by weight of basic impurities and amphoteric oxides capable of forming salts with the basic impurities, the amphoteric oxides being present in approximately the stoichiometric amount required to convert the impurities into salts.

**Spark plug.** C. E. BERSTLER. U. S. 2,330,807, Oct. 5, 1943 (Oct. 12, 1940). A. J. HOPKINS. U. S. 2,331,029, Oct. 5, 1943 (Nov. 18, 1940).

## Equipment and Apparatus

**Applications of the high resolving power of the electron microscope.** H. GREEN AND E. F. FULLAM. *Jour. Applied Physics*, **14** [7] 332–40 (1943).—The high resolving power attained with the electron microscope, fifty times that of the optical microscope, has extended the field of pigment microscopy to cover particles falling within the range of 0.20 to 0.004 micron. Many particles come into view that would otherwise be invisible, and diffraction disks now give way to definite shapes. The possibilities are illustrated with comparison photographs of zinc oxides, iron blue, hydrated ferric oxide, and Attapulgus clay. A stereoscopic electron micrograph of china clay at 3100× reveals the hexagonal shape and the thinness of the particles, illustrating one advantage of the large depth of focus. A.P.

**Applications of mass spectrometric analysis to chemistry.** D. RITTENBERG. *Jour. Applied Physics*, **13**, 561–69 (1942).—With the concentration of the heavy isotopes of hydrogen, carbon, nitrogen, oxygen, and sulfur, a new type of experimentation has become possible. Investigations on the isotope abundances of C, H, O, and N have shown little variation with source. The isotope technique, radioactive or stable, has made available a means of labeling a molecule or a portion of a molecule and following it through a series of chemical reactions. Examples are given from such fields as analytical chemistry, reaction kinetics, reaction mechanism, and biological chemistry. A.P.

**Colorimetry in the service of ceramic technology.** ISAY A. BALINKIN. Presented at meeting of the Ohio Section of the American Physical Society, Columbus, Ohio, Nov., 1942; abstracted in *Ohio State Univ. Eng. Expt. Sta. News*, **15** [2] 7 (1943).

***Determination of the true impact-bending strength of ceramic masses.** O. BARTSCH. *Ber. Deut. Keram. Ges.*, **22** [8] 292–312 (1941); abstracted in *Physik. Ber.*, **23** [5] 645 (1942).—The impact-bending strength of various ceramic masses and of glasses was determined with a specially developed pendulum hammer and with particular consideration of the energy lost in the parts flying off the specimens. In contrast to the apparent impact-bending strength, the true impact-bending strength ($s$) of ceramic masses increases with increasing section ($q$) according to the approximation formula $s = C \times q^{0.57}$. The true impact-bending strength of fire-clay masses decreases with an increasing number of blows, the decrease being greater, the smaller the section of the specimen. M.HA.

**Diffraction adapter for the electron microscope.** J. HILLIER, R. F. BAKER, AND V. K. ZWORYKIN. *Jour. Applied Physics*, **13**, 571–77 (1942).—An adapter has been developed which allows a conventional electron microscope to be used interchangeably as an electron diffraction camera or as an electron microscope. The adapter comprises a unit which takes the place of the projection lens unit of the microscope and includes a newly designed projection lens, a specimen holder, and a focusing lens. Diffraction patterns may be obtained by either reflection or transmission. Lattice spacings agree with X-ray values to within 0.5%. Typical diffraction patterns are shown side by side with accompanying electron micrographs obtained within a few minutes of each other. They include the following ceramic materials: zinc oxide, monohydrated aluminum oxide, and magnesium oxide smoke. A.P.

**Electrolytic polishing of metals.** S. WERNICK. *Chem. & Ind.*, **62** [26] 238–43 (1943).—Electrolytic polishing has developed broadly along two well-defined lines. It has become an important laboratory tool in the preparation of metallographic sections, and it is being used industrially for polishing metal surfaces. It is the degree of control that makes the polishing process economically attractive in competition with mechanical polishing methods. The industrial applications are complicated by the following practical difficulties: (1) the maintenance of optimum operating conditions, (2) the particular shape of the article to be polished, (3) the high current densities required, and (4) the high operating temperatures. The technical phases of stainless-steel polishing are discussed. The comments of specialists are included in the discussion of the paper. R.H.B.

**Electrostatic electron microscopy: I–III.** C. H. BACHMAN AND S. RAMO. *Jour. Applied Physics*, **14** [1] 8–18; [2] 69–77; [4] 155–60 (1943).—Investigations were made with the objective of developing a simplified, practical microscope of the type which yields magnified images of transparent specimens with a resolving power superior to that of the best light microscopes. The general problem of design includes consideration of the electron gun which serves to illuminate the specimen and the imaging lenses which magnify the electron image of the specimen onto the screen or plate. Comparisons are made with the magnetic-lens type of microscope. The discussion includes depth of focus, lens and field stops, choice of the number of stages of magnification, and alternative methods of recording and viewing the final image. An instrument has been built embodying the conclusions from the analytical approach. The resolving power range was chosen to be ten times superior to that of the light microscope, or about 200 a.u. Maximum simplicity in manufacture, operation, and maintenance was also sought. A.P.

**Foresight is better than hindsight in a maintenance program.** ANON. *Brick & Clay Record*, **102** [5] 38 (1943).—A highly profitable maintenance program adopted by

* Obtained from microfilm.

the Wadsworth Brick & Tile Co. requires periodic machinery inspection and reports from foremen. The following rules are given: (1) check equipment periodically; (2) record condition of equipment; (3) repair or replace equipment before efficiency is decreased beyond economic operation; (4) redesign equipment requiring too frequent repairs or replacements; and (5) check closely the performance of redesigned equipment, regardless of its degree of satisfactoriness. B.C.R.

**Future of induction heating.** F. W. CURTIS. Read before Machine Tool Forum, East Pittsburgh, Pa.; abstracted in *Heat Treating & Forging*, **29** [8] 402–404 (1943).—Induction heating units may be of the low or of the high frequency type. The latter will find greatly increased use in the future. With it, heat can be inducted for localized heating without heating the entire part. Depth of heat can also be controlled. In addition to its use in hardening, it can be used for melting metal in relatively small charges. Metal in a crucible holding 10 to 30 lb. melts in 50 to 60 min. A copper tube coil is wound around the crucible with an insulating layer of powdered Alundum and asbestos. M.R.

**Gas analysis with the mass spectrometer.** J. A. HIPPLE. *Jour. Applied Physics*, **13**, 551–59 (1942).—Gases containing several molecular species can be analyzed with the mass spectrometer. The gas to be studied is first ionized by an electron beam of controlled energy. Forty-eight gases have already been studied. Five-component mixtures of hydrocarbons have been successfully analyzed. Applications include (1) testing nitrogen used in annealing furnaces for freedom from oxygen of the order of 0.001%; (2) finding traces of carbon compounds; (3) analysis of the rare gas atmosphere in sealed-off electronic devices, only a $^1/_{10}$-cc. sample being needed; (4) in tracer work with stable isotopes; (5) rapid and more complete analysis of mixtures; and (6) continuous indication of changing composition during a process. A portable instrument is described. A.P.

**How to run a grinding machine.** ANON. *Amer. Machinist*, **87** [18] 105–20 (1943).—A comprehensive review of the types and the purposes of grinding, mounting, balancing, truing, and dressing of grinding wheels and coolants is presented. M.HA.

**How to select heating units for industrial applications: I–IV.** W. C. STEVENS. *Ind. Heating*, **9** [9] 1138–46; [12] 1634–40 (1942); **10** [2] 212–16; [9] 1278–80, 1284 (1943).—Data and calculations involved in the proper selection of electrical heating equipment are discussed in detail, and types of heating apparatus for room heating, water heating, etc., are described. Curves for specific heats of many substances, heat contents, thermal losses, and the calculation of power requirements are given, and many examples in different fields of industrial heating are calculated. M.HA.

**Inexpensive power unit for high-voltage direct current.** G. WELCH AND F. E. BLACET. *Jour. Chem. Education*, **17** [10] 484–85 (1940).—An easily constructed rectifier, operating on 240 volts, 3 phase a.c. and producing 270 volts d.c. with a load of 2.5 amp., is described. S.Z.

***Influence of color sensitivity on temperature readings with Bioptrix pyrometers.** S. FORNANDER. *Jernkontorets Ann.*, **125**, 67–80 (1941); abstracted in *Physik. Ber.*, **23** [5] 617 (1942).—Readings made by observers with differing color sensitivities varied greatly. One observer with a very weak sensitivity for green could not determine the color temperature within 100°C. M.HA.

**Insulation-resistance meter.** R. N. BUSHMAN. *Gen. Elec. Rev.*, **46** [7] 403–405 (1943).—Any device to measure insulation resistance, especially if it is to be used in production and service, should have the following features: (1) portability, (2) simplicity of operation, (3) easily readable resistance scales even in poorly illuminated locations, (4) a guard system to intercept surface leakage, and (5) maximum safety for the operator during use. A new portable electronic instrument usable up to 20,000 megohms has been designed which meets these specifications. Illustrated. L.E.T.

**Interpretation of electron micrographs of silica surface replicas.** R. D. HEIDENREICH. *Jour. Applied Physics*, **14** [7] 312–20 (1943).—Electron microscope pictures produced by either the polystyrene-silica or Formvar method are of limited value unless means of interpreting the results are developed. Stereomicrographs are found to be of value in interpretation when considered along with the intensity distribution of the image. The light and electron microscope pictures are strikingly similar with corresponding regions easily recognizable. A.P.

**Know electronics—it may reveal new applications for ceramic industry.** ANON. *Ceram. Ind.*, **41** [2] 32–33 (1943).—The theory of electronics is briefly explained, and several technical applications of interest to the ceramic manufacturer are given. Illustrated. H.T.

**Measurement of relative abundance with the mass spectrometer.** E. B. JORDAN AND N. D. COGGESHALL. *Jour. Applied Physics*, **13**, 539–50 (1942).—The authors discuss the general methods used in mass spectrometry, machine design, and possible sources of error. Graphs allow determination of the critical constants of the usual types of instruments. A.P.

**Metering steam in factories.** M. W. THRING. *Power & Works Engr.*, **37**, 187–89, 192 (July, 1942); abstracted in *Brit. Coal Utilization Research Assn. Bull.*, **6**, 69 (Sept., 1942); *Woodall-Duckham Tech. Press Rev.*, No. 878, p. 5 (Oct. 14, 1942).—T. describes an easily made steam flowmeter of the orifice type which has been designed by the B.C.U.R.A. at the request of the Ministry of Fuel and Power for use in boiler houses where none of the commercially available steam meters is installed.

**Modern pyrometric equipment on gas-fired appliances.** ANON. *Gas Times*, **31**, 7–8 (April 4, 1942); abstracted in *Woodall-Duckham Tech. Press Rev.*, Abs. No. 447.—Illustrated descriptions are given of recording, controlling, and indicating equipment used in conjunction with thermocouples on gas-fired appliances.

**Penetrometer method for determining the flow properties of high-viscosity fluids.** W. W. PENDLETON. *Jour. Applied Physics*, **14** [4] 170–80 (1943).—The theory of the penetrometer is developed to permit determination of absolute viscosities for both viscous flow and generally viscous flow (viscosity dependent on rate of shear in the range $10^6$ to $10^{12}$ poises). The new method was checked with the capillary viscometer and with the revised axially moving cylinder method. Earlier formulas for standard instruments based on viscous flow are invalid when applied to fluids showing generally viscous flow problems. In addition to possessing speed of operation and precision, the penetrometer minimizes the elastic effects and permits reproducibility without extensive heat-treatment and preworking. Entire shearing stress-rate of shear curves can be determined with one load and one penetration using a succession of time intervals. A.P.

**Preparation of Weston standard cells.** W. C. VOSBURGH AND P. F. DERR. *Jour. Chem. Education*, **18** [2] 87–89 (1941).—Detailed directions for the preparation of Weston cells in the laboratory are given together with data from such cells. S.Z.

**Proposal for the extension of our system of mensuration.** E. C. BINGHAM. *Jour. Applied Physics*, **14** [4] 196–98 (1943).—As a means of making comparable the various units of length in the English and metric systems and the great range of distances between light years and X-ray wave lengths, B. proposes the use of the logarithm of the length expressed in centimeters, which he calls *qD*. Industrially, the system would be useful because gauges would have uniform spacings, scaling up sizes would be simplified, and the designation of sizes would be on a uniform system. A.P.

**Radiant gas heat in baking, curing, and drying operations.** CARL P. MANN. *Gas Age*, **92** [6] 21–23 (1943).—Any gas may be used, but the burners must be designed for the gas and for the application. Radiant sources must be so placed that their rays are directed toward the work in process. Plaster molds used for fine china are now dried

* Obtained from microfilm.

in one hour instead of 24 hr. Radiant heaters outside the glass tubing for fluorescent lamps bake the coating on the inside. China-firing kilns are being operated up to 2400°F. with a temperature distribution throughout the working space of ± 5°F. W.D.F.

**Radio-frequency capacitometer.** FRANK J. MOLES. *Gen. Elec. Rev.*, **46** [8] 457–59 (1943).—A self-contained cathode-ray tube instrument for precise radio-frequency measurement of capacitance and inductance is described. This capacitometer fills the need for a complete, compact, precise device for measuring capacitance and inductance in engineering and design departments, laboratories, and schools. 2 illustrations, 3 diagrams. L.E.T.

**Rapid infrared analytical method for hydrocarbon mixtures and a routine spectrophotometer for plant control.** R. R. BRATTAIN AND O. BEECK. *Jour. Applied Physics*, **13,** 699–705 (1942).—Through the construction of special equipment, a rapid method for infrared spectroscopic analysis of simple mixtures of hydrocarbons has been reduced to a routine procedure which can be used by inexperienced operators for control work in plant operation. A.P.

**Repair worn parts and surfaces by welding and metallizing.** HUGO FILIPPI. *Brick & Clay Record*, **102** [4] 22 (1943).—Worn or broken equipment can often be restored to its original life by welding or metallizing the worn surfaces. In metallizing, such metals as aluminum, copper, brass, bronze, lead, nickel, cadmium, tin, zinc, stainless and carbon steels, and Babbitt metal may be used. The resultant deposit of metal is rough and requires some finishing; being porous, it is very suitable for bearing surfaces. Examples of equipment repaired by either of these two methods are cited. B.C.R.

**Short history of isotopes and measurement of their abundances.** E. B. JORDAN AND L. B. YOUNG. *Jour. Applied Physics*, **13,** 526–38 (1942).—Mass spectrometry is concerned with abundance measurements and allied work on isotopes. Four kinds of instruments used for this purpose are described. A.P.

**Simple steam meter.** ANON. *Bull. Fuel Efficiency Comm. Ministry of Fuel and Power*, No. 6; abstracted in *Colliery Guardian*, **165,** 450 (Oct. 9, 1942); *Woodall-Duckham Tech. Press Rev.*, No. 878, p. 5 (Oct. 14, 1942).—A description is given of a simple steam meter which can be made in any works possessing an average workshop. The construction, installation, and use of the meter are carefully and minutely described.

**Simple temperature indicators from 125° to 1600°F.** ANON. *Laboratory*, **14,** 34–35 (1943).—The new Tempil Pellet is a tablet which melts at an exact stated temperature. Each one is stamped with the temperature at which it melts and is of a distinctive color. Tempil Pellets are available for melting points between 750° and 1600°F. in 50° intervals. They extend the range of Tempilstiks. See *Ceram. Abs.*, **22** [10] 178 (1943). W.D.F.

**Spherical furnace calorimeter for direct measurement of specific heat and thermal conductivity.** JOHN R. WINCKLER. *Jour. Amer. Ceram. Soc.*, **26** [10] 339–49 (1943).—18 references, 12 figures.

**Surface tension and its measurement.** A. FERGUSON. *Endeavour*, **2** [5] 34–38 (1943).—The simple apparatus required for the accurate measurement of the surface tension of liquids at various temperatures is described, and the need for further data, especially of homologous series, is emphasized. L.R.B.

**Take care of your machines and equipment.** ANON. *Brick & Clay Record*, **102** [4] 17–22 (1943).—Factors relating to the care and maintenance of electric motors, pit shovels and locomotives (electric), wire rope, Diesel engines, vibrating screens, drier cars, auger-machine bearings, control instruments, centrifugal pumps, belting, elevator and transmission belts, and chain drives are discussed. B.C.R.

**Thermocouples for use in liquid steel—technique of calibration.** ANON. *Iron & Coal Trades Rev.*, **145** [3896] 1063–64 (1942).—A furnace assembly recommended by the National Physical Laboratory (Great Britain) for the calibration of Pt thermocouples for use in liquid steel in the range 1400° to 1770°C. is described. The furnace is an electrically heated tube of sintered alumina, the winding being pure Pt or 10% Rh-Pt. M.HA.

***Vibration-viscosimetric determinations on concentrated suspensions.** H. ERBRING AND S. BROESE. *Kolloid-Z.*, **100,** 332–35 (1942).—Vibration viscosimetry consists in measuring the viscosity of a substance in a capillary viscosimeter (Ostwald) subjected to vibration. The effect of periodic vibration on viscosity is determined thereby. The viscosity of, e.g., a 10% bentonite suspension could not be measured ordinarily, because the suspension would gel. When a vibration viscosimeter is used, however, the gel liquefies thixotropically under the influence of the vibration, thus permitting the determination of the viscosity. The degree to which the structure of the gel is disturbed depends on the intensity of the vibration. This relation can also be determined with the aid of this apparatus, and the gradual solidification of the gel can be studied. The later phenomenon can be investigated in the usual type of viscosimeter only with great difficulty. Suspensions of 5, 10, and 15% bentonite were studied in this type of viscosimeter. Talc, blanc fixe, and mixtures of a 10% bentonite suspension with various amounts of the two were also investigated. The amplitudes used were 0.4 to 1.2 mm. For any one concentration, the viscosity drops with increasing amplitude. No liquefaction could be induced by supersonic waves. Only by using waves of the audible region could the gels be liquefied. The results are tabulated and presented in curves. M.HO.

SEPARATE PUBLICATIONS

**Hardness.** D. LANDAU. Published by the Nitralloy Corp., New York, 1943. 106 pp. Free.—An exposition of P. Roudié's work showing that hardness might be reduced and expressed in terms of length, mass, and hardness. The history of hardness tests is briefly traced from Aristotle in 384 B.C. to the present day. After defining and discussing the physical properties involved, L. explains Roudié's dynamic hardness and shows that the physical property of hardness has not yet been fully analyzed. 60 references, 71 figures. Illustrated.

**Hardness and Hardness Measurements.** SAMUEL R. WILLIAMS. American Society of Metals, Cleveland, 1942. 558 + vii pp. Price $7.50. Reviewed in *Jour. Applied Physics*, **14** [5] 220 (1943). A.P.

PATENTS

**Abrading apparatus.** W. L. KEEFER (Pangborn Corp.). U. S. 2,329,203, Sept. 14, 1943 (June 21, 1941); divided out of U. S. 2,246,522, June 24, 1941 (March 10, 1938).

**Coating ceramic articles.** E. H. FISCHER (Westinghouse Electric & Mfg. Co.). U. S. 2,329,114, Sept. 7, 1943 (July 24, 1940).

**Heat-insulating material.** A. H. HAPPE (H. A. Sperlich). U. S. 2,328,644, Sept. 7, 1943 (Jan. 25, 1941).—A composition of matter consisting of a vitrified mass of particles of exfoliated vermiculite, siliceous binding material, and green oxide of chromium.

**Mass spectrometer.** J. A. HIPPLE, JR. (Westinghouse Electric & Mfg. Co.). U. S. 2,331,189, Oct. 5, 1943 (Oct. 30, 1940). U. S. 2,331,190, Oct. 5, 1943 (Aug. 2, 1940).

**Procedure and apparatus for separating solids from liquids.** WESTFALIA-DINNENDAHL-GRÖPPEL A.-G. Belg. 440,107, Jan., 1941.—The slurry to be clarified is fed into the clarifier in the form of a liquid column of such length that even the smallest solid particles reach the periphery of the column, whereas the clear water leaves the clarifier in a radial direction. M.HO.

**Process and apparatus for grading and coating with comminuted material.** N. E. OGLESBY (Behr-Manning Corp.). U. S. 2,328,577, Sept. 7, 1943 (Jan. 12, 1940).

**Rotary kiln having several burners staggered along its length and around its circumference.** METALLGES., A.-G. Belg. 440,108, Jan., 1941.—Details of construction are given. M.HO.

**Tracer mechanism for investigating surface irregularities.** E. J. ABBOTT (Physicists Research Co.). U. S 2,330,801, Oct. 5, 1943 (Dec. 26, 1939).

* Obtained from microfilm.

## Kilns, Furnaces, Fuels, and Combustion

**Air-operated controllers used to control tunnel kilns.** ANON. *Ceram. Ind.*, **41** [2] 34–35 (1943).—The installation of a temperature- and draft-control system on a tunnel kiln for firing electrical porcelain results in improved ware. The system described is simple to install and has a low initial cost. 4 illustrations. H.T.

**Ash-fusion studies.** E. G. BAILEY. Presented at West Virginia Fuel Engineering Conference; abstracted in *Coal Age*, **47** [9] 87; *Eng. & Boiler House Rev.*, **57**, 56–57 (Feb., 1943); *Woodall-Duckham Tech. Press Rev.*, No. 892, p. 2 (Feb. 3, 1943).—A study is made of the softening and fusion temperatures of ash in an oxidizing atmosphere. The practical significance of this investigation is that many coals which would formerly have been unsatisfactory are now entitled to preference when modern combustion methods and equipment are used. A chart shows the temperatures at which ash in various parts of a two-stage slag-tap furnace will deform, soften, and flow in reducing and oxidizing atmospheres and the relation of temperature characteristics to the nature of iron compounds in the ash.

**Behavior of sulfur in lignite in the temperature range between drying and low-temperature carbonization.** E. RAMMLER AND J. GALL. *Braunkohle*, **41**, 437–40, 453–56 (1942); abstracted in *Bull. Brit. Coal Utilization Research Assn.*, **7**, 10 (Jan., 1943); *Woodall-Duckham Tech. Press Rev.*, No. 895, p. 2 (Feb. 24, 1943).—Laboratory experiments showed that the sulfur content of lignites could be reduced 60 to 70% by heating the coal in a stream of hydrogen at about 300°C. for 30 min. Steam and low-temperature gases containing about 20% hydrogen were also reasonably effective. Experiments made with magnesium chloride resulted in reductions of up to 40% and 35% in the sulfur and ash contents, respectively.

**Bituminous coal research.** ANON. *Coal Age*, **47** [7] 43; abstracted in *Colliery Eng.*, **19**, 296 (Dec., 1942); *Woodall-Duckham Tech. Press Rev.*, No. 886, p. 2 (Dec. 9, 1942).—An account is given of a conference and exhibition at the Battelle Memorial Institute for the presentation of first results from the $200,000 program of research commenced by Bituminous Coal Research, Inc., in the fuel laboratories of the Institute in November, 1940. The general aim is to increase and improve the use of coal. Improvements are being effected in heating stoves of all sizes, industrial furnaces, and the metallurgical uses of coal. Research has made it possible to use coals with a wide range of specifications for given services instead of the particular coal hitherto regarded as indispensable.

**Bogus fuel-saving preparations in theory and practice.** M. FIELDEN. *Iron & Coal Trades Rev.*, **146** [3910] 191–92 (1943).—F. explodes the fantastic claims made for so-called "fuel savers" or "fuel economizers" sold in England for use with coal and coke, especially in domestic fireplaces. M.HA.

**Calculation of the calorific value of coals from analytical data.** W. SCHEER. *Glückauf*, **78**, 52–53 (1942); abstracted in *Fuel Research Intelligence Section, Summary for Two Weeks Ending Feb. 28 and March 7, 1942*, p. 121; *Woodall-Duckham Tech. Press Rev.*, No. 850, p. 3 (April 1, 1942).—Formulas are derived for the calculation of the calorific value of coals from data obtained by "short" analysis. As the chemical structure of coal substance is not yet completely understood, empirical constants are introduced into the formula to represent the elementary constituents of the coal. The theories of various formulas are discussed.

**Combustion principles should be applied when firing downdraft kilns: II, Drafts.** H. L. LONGENECKER. *Brick & Clay Record*, **102** [4] 37–40 (1943).—At the completion of the water-smoking and oxidizing periods, the draft may be reduced to $^2/_{10}$ in., thereby requiring a thin fire and little coal to hold the finish heat. The use of a suitable and uniform coal supply is important, screened coal being worth the small additional cost. Coal that emits its volatile matter slowly can be controlled better than the type which volatilizes quickly. Insulation of flues provides some savings in fuel. Knowledge of the firing behavior of the clay is essential for the establishment of the proper firing schedule. Where possible, the use of pyrometric cones is recommended in preference to determining the amount of settle or the use of draw trials. See *Ceram. Abs.*, **22** [6] 106 (1943). B.C.R.

**Development of the shaft kiln and its use for the calcination of fire clay.** C. KABUS. *Tonind. Ztg.*, **65**, 365, 376, 386, 396, 406 (1941); abstracted in *Trans. Brit. Ceram. Soc.*, **41** [3] 36A (1942).—The development of the shaft kiln is traced through the patent literature. This type of kiln is compared with the downdraft chamber and tunnel kilns for grog production. The design of the shaft kiln must be adjusted to the firing shrinkage of the clay to be treated; the length of the preheating zone must be considered in relation to the drying characteristics of the clay. Mixed solid fuel and gas firing are considered; the latter is preferable, as the former results in contamination of the grog. The shaft kiln with mechanical charging and distributing mechanisms is considered ideal for firing grog. It is particularly economical in fuel and labor and occupies little space. Some of the difficulties encountered in controlling the passage of the clay down the shaft are mentioned. Tables compare the initial and maintenance costs of chamber, annular, and shaft kilns for the production of 50 tons of fired grog per day.

**Industrial combustion hazards: I, Potential explosion sources; II, Flame-failure safety devices.** T. A. COHEN. *Ind. Heating*, **10** [7] 958–64; [8] 1111–16 (1943).—The potential explosion sources in direct-fired boilers, industrial furnaces, ovens, and processing kettles are discussed exhaustively, and means for preventing explosions and flame-failure safety devices are described in detail. M.HA.

**Nomograph for *P-V-T* relations of gases below the critical point.** GEORGE W. THOMSON. *Ind. Eng. Chem.*, **35** [8] 895 (1943). F.G.H.

**Origin and composition of coals.** R. A. MOTT. *Fuel*, **21**, 129–35 (Nov.-Dec., 1942); **22**, 20–26 (Jan.-Feb., 1943); abstracted in *Woodall-Duckham Tech. Press Rev.*, No. 893, p. 2 (Feb. 10, 1943).—M. studied the mode of origin of coal seams and the mode of their development in composition. Suggestions are made on the origin and development of durains, particularly in coals of low rank.

**Orsat data versus true combustion efficiency.** R. REED. *Gas Times*, **34**, 92–93 (Feb. 6, 1943); abstracted in *Ind. Gas*; *Woodall-Duckham Tech. Press Rev.*, No. 893, p. 2 (Feb. 10, 1943).—Although Orsat flue-gas data are usually correct, there are exceptions due to the following sources of error: (1) lack of means of determining the presence of aldehydes, $H_2$, or free carbon; (2) the manner of obtaining the sample and the point at which the sample is taken; (3) the presence of alkalis in the water used in the burette and leveling bottle to pass the sample back and forth through the solutions where the various gases are absorbed. A few specific cases are indicated where interpretation of Orsat flue-gas data led to wrong conclusions.

**Phase equilibria in hydrocarbon systems: 34, Joule-Thomson coefficients in the methane-propane system.** R. A. BUDENHOLZER, D. F. BOTKIN, B. H. SAGE, AND W. N. LACEY. *Ind. Eng. Chem.*, **34** [7] 878–82 (1942).—Joule-Thomson coefficients of three mixtures of methane and propane were determined experimentally at pressures up to 1500 lb. per sq. in. in the temperature interval between 70° and 310°F. From these experimental data and published heat-capacity values for the components at infinite volume, the isothermal enthalpy-pressure coefficients were calculated. From these derived values the partial enthalpies of methane and propane in mixtures of the two substances were established. The results are presented in graphical and tabular form. **39, Volumetric behavior of methane.** R. H. OLDS, H. H. REAMER, B. H. SAGE, AND W. N. LACEY. *Ibid.*, **35** [8] 922–24 (1943).—The volumetric behavior of methane was investigated at pressures up to 10,000 lb. per sq. in. in the temperature interval between 100° and 460°F. The results of the experimental

work are presented in tabular form and are compared with values obtained in earlier investigations. Illustrated. F.G.H.

**Practical experience in the most efficient method of drawing off crude gas.** G. FRANKE. *Gas- & Wasserfach*, **85**, 45–50 (1942); abstracted in *Fuel Research Intelligence Section, Summary for Week Ending June 27, 1942*, p. 345; *Woodall-Duckham Tech. Press Rev.*, No. 865, p. 2 (July 15, 1942).—F. describes the effect on the fouling of fittings and mains of drawing off crude gas (1) with strong suction without adding water gas and (2) with weak suction with water gas and stresses the importance of careful supervision of the cooling, pressure, and vacuum conditions, especially in the case of ovens. The following factors were investigated: the O, CO, $CO_2$, and N contents of the gas; the effect of strong suction on the oven and on the quality of the gas; the utilization of the combustion of the coke under strong suction for the production of water gas; difficulties due to gums and gum formers; and the pressure and vacuum conditions between oven and suction plant.

**Preparation problems in the U. S.** ANON. *Coal Age*, **47** [5] 83; abstracted in *Colliery Eng.*, **19**, 295 (Dec., 1942); *Woodall-Duckham Tech. Press Rev.*, No. 886, p. 3 (Dec. 9, 1942).—Oil treatment, drying, and bases of selection of coal for power plants were among the topics discussed recently by the Illinois Society of Preparation Engineers and Chemists. Particulars are given of an installation of Christie kiln-type units with driers $7^1/_2$ ft. in diameter by 60 ft. long on a 1 in 12 slope. Coal is discharged at 135°F., and moisture is reduced from 18 to 20% to about 1%. Coal with 1 or 2% moisture is better than dry coal for oil treatment. Calorific value is normally the deciding factor in the purchase of coal for power generation.

**Radiation of luminous flames. Research results and their application to boiler firing.** P. O. VEH. *Arch. Wärmewirt.*, **23**, 61–64 (1942); abstracted in *Fuel Research Intelligence Section, Summary for Two Weeks Ending July 4 and 11, 1942*, p. 372; *Woodall-Duckham Tech. Press Rev.*, No. 868, p. 5 (Aug. 5, 1942).—The heat radiation of luminous flames is greater than that of nonluminous flames because of the heat radiation of solid carbon particles. The intensity of this radiation depends on the concentration of the particles and on their temperatures. The solid carbon particles are expelled by the action of high temperatures from hydrocarbons during the formation of higher carbon molecules. A study is made of the factors on which this conversion of hydrocarbons (auto-carburation) depends. The application of the results obtained to the fuel and firing of boilers is discussed.

**Specific heats of certain gases over wide ranges of pressures and temperatures.** F. O. ELLENWOOD, N. KULIK, AND N. R. GAY. *Cornell Univ. Eng. Expt. Sta. Bull.*, No. 30, 1942; abstracted in *Fuel Research Intelligence Section, Summary for Three Weeks Ending Feb. 20 and 27 and March 6, 1943*, p. 78; *Woodall-Duckham Tech. Press Rev.*, No. 900, p. 2 (March 31, 1943).—Data for air, $CO_2$, CO, $C_2H_4$, $H_2$, $CH_4$, $N_2$, and $O_2$ at 0 to 4000°F. and 0 to 10,000 lb. per sq. in. are presented.

**Volatile matter of coal.** C. E. SPOONER. *Fuel*, **22** [Jan.-Feb.] 13–19; [March-April] 39–46 (1943); abstracted in *Woodall-Duckham Tech. Press Rev.*, No. 901, p. 2 (April 7, 1943).—S. has developed formulas whereby the total amount of volatile matter and the amounts of its constituents, viz., water, tar, light oil, oxides of carbon, hydrogen, methane, ethane, ethylene, and nitrogen, can be deduced from a knowledge of the hydrogen and oxygen contents of a coal. These formulas apply particularly to coals with oxygen contents up to about 10%. This paper is concerned with improvements in the formulas to make them applicable to coals over the whole range of oxygen content and to show the effect of the presence of durain and fusain in a mixture with bright coal on the amount and composition of the volatile matter.

**What's happening inside your kiln? XIV, Excess air.** L. R. WHITAKER. *Brick & Clay Record*, **102** [5] 29–31 (1943).—An article by H. C. Kenyon (*ibid.*, **69** [7] 502–504 (1926)) is reprinted. For Part **XIII** see *Ceram. Abs.*, **22** [6] 106 (1943). B.C.R.

## Geology

**Acid solubility of aluminum oxide in the separate constituents of clays.** K. SARNECKI. *Przemysl Chem.*, **23**, 241–44 (1939); abstracted in *Chem. Zentr.*, **1939, II**, 3796.—The solubility of $Al_2O_3$ in minerals containing $Al_2O_3$ depends on the form in which it is present. The different forms, the first two of which are difficultly soluble, include corundum, $\alpha$-$Al_2O_3$; diaspore, $\alpha$-$Al_2O_3 \cdot H_2O$; boehmite, $\gamma$-$Al_2O_3 \cdot H_2O$; and hydrargillite or gibbsite, $\gamma$-$Al_2O_3 \cdot 3H_2O$. The solubility of gibbsite increases with higher acid concentrations, while that of diaspore is 0 up to 18% HCl. The transformation of one form into another depends on the temperature. Kaolin is difficultly soluble when heated above 900°; at lower temperatures, however, a material is obtained which is easily soluble in acid. Halloysite is more soluble in HCl than kaolin, and when the temperature is raised, a sudden dehydration is noted in the beginning; this distinguishes it from allophane, whose rate of dehydration is uniform. In the unheated state the latter has the greatest solubility in comparison with other Al minerals. M.V.C.

**Autoradiography of minerals.** CLARK GOODMAN AND GEORGE A. THOMPSON. *Amer. Mineralogist*, **28**, 456–67 (1943).—Using stray slow neutrons from the cyclotron on elements having large nuclear cross sections for neutron reactions ($n$, $\gamma$) and yielding radioactive isotopes of convenient half-periods, autoradiographic studies of a number of common minerals were made. The loci and relative concentrations of the activated elements in these minerals are determined by placing polished sections of the specimen in direct contact with photographic film. The source of the effective $\beta$ radiation is determined from the decay rate and intensity of the activity. A reconnaissance study has been made of minerals containing manganese, gold, copper, tungsten, phosphorus, potassium, barium, sodium, and arsenic. W.D.F.

**Chemical consolidation of loose ground: the Joosten process in practice.** ANON. *Chem. Trade Jour.*, **112** [2912] 255 (1943).—In the invention of a Dutch engineer, Hugo Joosten of the Tiefbau and Kalteindustrie, Nordhausen, clear aqueous solutions are forced alternately through separate pipes into loose gravel and sands and there form silica gel. The liquids combine instantaneously on contact. The process is also used for sealing concrete through which water is percolating; a borehole is made near the point of issue, a special "gun" is inserted, and the water pushed back by one solution which is then quickly followed by the second. L.R.B.

**Clays from Bilaspur State (Punjab).** M. L. MISRA, B. PRASAD, AND M. B. YADAV. *Trans. Indian Ceram. Soc.*, **2** [1] 32–40 (1943).

**Genesis of granitic pegmatites.** N. M. USPENSKY. *Amer. Mineralogist*, **28**, 437–47 (1943).—The pegmatites occur in Gold Mountain, Borshov range, 120 km. south of Nerchinsk, Transbaikal. Quartz rods radiate out from a center into feldspar crystals which may be of any orientation. After all the rods have grown the same distance they may thicken or thin, all by an equal amount, and later repeat. An aplite dike was originally formed; a later solution dissolved some of the aplite, and the rest recrystallized to form pegmatite. The solution diffused into the graphic intergrowth zone, which was the coolest. Here the quartz rods and feldspar crystallized at the same time. The supply of solution was nonuniform or it came in pulses; this explains the regular thickening and thinning of the quartz rods. W.D.F.

**Heavy-media separation plant of the Barton Mines Corp.** H. H. VOGEL. *Amer. Inst. Mining & Met. Engrs. Tech. Pub.*, No. 1578; *Mining Tech.*, **7** [3] 5 pp. (1943).—The property is on Gore Mt., 5 miles west of North Creek, N. Y. Almandite garnet occurs in a gangue which is principally

hornblende, with plagioclase, hypersthene, biotite, apatite, and pyrite. Mining operations have been carried on for 60 years; the garnet was separated first by hand and later by jigging. The plant uses a ferrosilicon medium, kept between 3.10 and 3.25, and is arranged to be operated by one man. The medium is consumed at the rate of 0.4 lb. per ton of mill feed. Chemical analyses are not useful in determining the grade of the product; samples are analyzed by screening, hand-picking the garnet, and weighing it. The heavy-media separation has resulted in (1) increased recovery of garnet, (2) more tonnage handled by the same labor, (3) recovery of more garnet in the range minus $^1/_2$ in. to plus $^1/_8$ in., and (4) savings in costs. W.D.F.

**Huntington-Heberlein sink-and-float process.** R. R. KNUCKEY. *Amer. Inst. Mining & Met. Engrs. Tech. Pub.*, No. 1609; *Mining Tech.*, **7** [4] 4 pp. (1943).—This process comprises the optimum conditions for separation: (1) elimination of disturbing currents in the separating zone, (2) reduction to a minimum of medium density-differences throughout the separation zone, (3) stable medium of minimum viscosity to permit the unretarded fall of mineralized particles, and (4) removal of products of separation with minimum disturbance of the separating zone. The separator is a pyramidal tank connected at the bottom to an inclined bucket elevator. By using a combination of cleaning methods, 99.85% of the medium is recovered. W.D.F.

**Laboratory experiments on the magnetization of rocks.** E. F. HERROUN AND A. F. HALLIMOND. *Proc. Phys. Soc.* [London], **55** [309] 214–21 (1943).—Specimens of natural rock masses collected by the Geological Survey were tested for magnetic susceptibility and permanent magnetization before and after various artificial treatments. After cooling in the earth's field, cut cubes were found to be magnetized with an intensity much greater than that of the natural rock, and the values decayed very little with time. When artificially magnetized in the cold, the cubes were only affected by fields above a certain value, and the decay was often considerable. Curves are given showing the decay with time and the demagnetization of the heated cubes by increasing fields. The susceptibility of natural rocks increases with the field, in some cases reaching a maximum between 50 and 100 c.g.s. These results are compared with the data of J. G. Koenigsberger. L.E.T.

**Magnesia from brucitic limestone.** ANON. *Chem. Trade Jour.*, **112** [2912] 249 (1943).—The method of Goudge (*Ceram. Abs.*, **20** [1] 29 (1941)) for the recovery of magnesia from brucitic limestone is being operated on a commercial scale in Quebec. The crushed and calcined limestone is hydrated just sufficiently to convert the lime to hydroxide, leaving granules of magnesia of $-10 + 35$ mesh. Brick made from these granules are highly resistant to spalling. L.R.B.

**Mozambique bauxite.** ANON. *Chem. Trade Jour.*, **112** [2916] 340 (1943).—White bauxite ($Al_2O_3$ 61, $SiO_2$ 10, $Fe_2O_3$ 1.2, total insolubles 13.0) is being mined in the Manica district, Portuguese East Africa, for conversion into aluminum sulfate and (mixed with magnesite) high-grade refractory brick. L.R.B.

**Organic matter of ball clays: I.** E. SHARRATT AND MARCUS FRANCIS. *Tech. Paper Brit. Pottery Research Assn.*, Feb., 1939; reprinted in *Trans. Brit. Ceram. Soc.*, **42** [6] 111–21 (1943).—Types of organic matter which may enter the soil are discussed with particular reference to their stability toward bacteriological action. Substances easily decomposed by microorganisms include monosaccharides, pentosans, hexosans, the proteins, and their derivatives. Part of this matter is assimilated as microbial protoplasm, but most of it is liberated as simple gases, such as carbon dioxide, etc. Resistant substances which tend to accumulate in soils include fats, waxes, tannins, resins, and lignitic matter. Of the organic matter of soils, a large fraction consists of lignitic matter, while another consists of complex compounds grouped together by some authors under the designation "humus." A review of the available data on these compounds is given. Possible methods of analysis of soil organic matter are discussed, particular attention being devoted to S. A. Waksman's "rational chemical analysis." By this method the soil organic matter is separated into (*a*) fats and waxes, (*b*) tannins and resins, (*c*) hemicelluloses, (*d*) celluloses, (*e*) ligno-celluloses, etc. R.A.H.

**Packing in ionic minerals.** H. W. FAIRBAIRN. *Bull. Geol. Soc. Amer.*, **54** [9] 1305–74 (1943).—Approximate quantitative values for the ratio ion volume/unit cell volume are given for about 200 minerals. F. proposes a "packing index" to express this relationship. The general correlation of this index with specific gravity, hardness, and mean refractive index is shown in detail. The role of the packing index in thermal inversion and incongruent melting seems mainly to be accessory, but it plays a vital part in pressure inversion. It is an important factor in controlling the maximum size of the minor ions which may enter a crystal structure. A general correlation is evident between the packing index and the order of crystallization, but apparently other factors control the processes. A.C.B.

**Preparation and properties of some compounds in the system $H_2O$–$Na_2O$–$P_2O_5$.** EARL INGERSON AND GEORGE W. MOREY. *Amer. Mineralogist*, **28**, 448–55 (1943).—Optical properties were measured on the 21 known compounds in this system. These are $Na_3PO_4$ with 0, 1, 7, and $12H_2O$; $Na_2HPO_4$ with 0, 2, 7, and $12H_2O$; $Na_4P_2O_7$ with 0 and 10 $H_2O$; $Na_5P_3O_{10}$ with 0 (two different phases) and $6H_2O$; $NaH_2PO_4$ with 0, 1, and $2H_2O$; $NaPO_3$ with 0 (two different phases) and $2H_2O$; and $Na_2H_2P_2O_7$ with 0 and $6H_2O$. For eight of the compounds, the data were taken from the literature; eight more have been restudied, and five are described optically for the first time. Crystallographic and density data are given for some. The methods of preparing twelve of these compounds are given, while the other methods are given in the literature cited. The nomenclature is discussed. Refractive indices are given for eleven glasses in the system $NaPO_3$–$Na_4P_2O_7$. W.D.F.

**Prismatic cleavage and steep rhombohedral form in $\alpha$-quartz.** J. DRUGMAN. *Mineralog. Mag.*, **25** [164] 259–63 (1939); abstracted in *Physik. Ber.*, **20** [12] 1300 (1939).—In general, $\alpha$-quartz only rarely shows well-defined faces of cleavage. D. describes a specimen (berg crystal) in which the cleavage is well pronounced in all three 60° directions. M.HA.

**Pyroxenes of basaltic magma.** FREDERICK WALKER. *Amer. Jour. Sci.*, **241** [8] 517–20 (1943).—Observations are presented on the pyroxenes of common basaltic magma, which are for the most part in agreement with the recent work of Hess. The effect of the volatile constituents on pyroxene crystallization is stressed. B.C.R.

**Radiogenic heat in rocks.** N. B. KEEVIL. *Jour. Geol.*, **51** [5] 287–300 (1943).—Using many new data, K. finds that the average value of heat production by radioactive disintegration in rocks is lower than recent estimates, which were considerably lower than the estimates of Holmes. The rate is lowered most for granitic and ultrabasic rocks, whereas little change is made in the rate for basic and intermediate-type rocks. K. finds also that a single alpha-ray measurement provides a satisfactory determination of the heat generated by radioactive disintegration, in contrast to the previous laborious separate determination of radium, thorium, and potassium. A.C.B.

**Recent applications of heavy-media separation (sink-float) processes.** S. J. SWAINSON, S. A. FALCONER, AND G. B. WALKER. *Amer. Inst. Mining & Met. Engrs., Tech. Pub.*, No. 1600; *Mining Tech.*, **7** [4] 26 pp. (1943).—Eight plants are now treating ores of lead and zinc, lead, iron, garnet, tin, and tungsten. Pilot-plant tests have recently been run on other ores. W.D.F.

**Recrystallization and flowage in Appalachian quartzite.** R. E. FELLOWS. *Bull. Geol. Soc. Amer.*, **54** [9] 1399–1432 (1943).—Intensity of the deformation of quartz-rich sedimentary rocks decreases northward and westward from the Piedmont crystalline rocks, at right angles to the trend of regional deformation. Petrofabric analyses were made of numerous field specimens. Five textural types of quartz were recognized: original grains, peripheral-growth quartz, crush quartz, needle quartz, and recrystallized quartz. A.C.B.

**Useful South African mineral: vermiculite and its applications.** ANON. *S. African Mining & Eng. Jour.*, Jan. 16, 1943; reprinted in *Chem. Trade Jour.*, **112** [2912] 252 (1943).—Since 1938, vermiculite has been produced in the Palaboroa area of South Africa. It occurs with serpentine over an area at least 900 yd. square and reaches to a depth of 60 ft. Further deposits occur northeast of Loolekop. The many uses for heat-treated vermiculite are described. L.R.B.

SEPARATE PUBLICATIONS

**Adsorbent Clays, Their Distribution, Properties, Production, and Uses.** P. G. NUTTING. *U. S. Geol. Survey Bull.*, No. 928-C, 94 pp. (1943). Supt. of Documents, Washington, D. C. Price 20¢.—Active and activable clays of the type used chiefly for decolorizing lubricating oils have been deposited in widely scattered localities and through a wide range of geologic ages. They are abundant in the southern part of the U.S. The geographic distribution of important deposits is given by states and countries, and their age is summarized. Physical properties, chemical composition, and the adsorbent properties of 75 leading deposits are discussed in detail. The special test methods developed for evaluating adsorbing power and for determining the best treatment for any given clay are described. The more important uses of adsorbent clays are discussed. R.A.H.

**Occurrence and Production of Vanadium.** GEORGE O. ARGALL, JR. *Quart. Colo. School Mines*, **38** [4] 56 pp. (1943).—Vanadium is used mainly in alloy steels; it is used in ceramics in colored glazes and in colored glass. Only in Peru and the Colorado Plateau is ore mined solely for its vanadium content. It is found in oils, organic matter, thermal waters, and igneous and sedimentary rocks. The sandstone ore deposits contain a series of rare minerals and have a wide areal but narrow stratigraphic occurrence. The vanadium minerals were deposited from solutions after the sands were deposited; these ore bodies are very pockety and irregular. The sandstone ores are given a salt roast and are water leached, and the enriched vanadium solutions are treated with sulfuric acid to form sodium hexavanadate. This is fused to give an 87% $V_2O_5$ concentrate, which is sold. Vanadium is also recovered from metallic vanadates, as a by-product of phosphate manufacture, and increasingly from oil soots and petroleum residues. The recent discovery and the development of a minable vanadium bed in the Phosphoria formation of Wyoming offer much hope for domestic ore reserves and future increased production. W.D.F.

**Porosity, Total Liquid Saturation, and Permeability of Illinois Oil Sands.** R. J. PIERSOL, L. E. WORKMAN, AND M. C. WATSON. *Illinois State Geol. Survey Rept. Investigations*, No. 67, 72 pp. (1940).—Tabulated and graphic results are given of tests for the porosity, saturation, and permeability of forty-five cores representing ten Illinois producing formations. 39 figs., 53 tables.

**Potash in North America.** J. W. TURRENTINE. American Chemical Society Monograph Series, No. 91. Reinhold Publishing Corp., New York, 1943. 186 pp. Price $3.50. Reviewed in *Chem. & Eng. News*, **21** [11] 924 (1943). F.G.H.

PATENT

**Highly activated decolorizing earths.** IPARI ROBBANÓANYAGGYÁR R.T. (AKT.-GES. FÜR INDUSTRIELLE SPRENGSTOFFE) AND H. BERCZLI. Belg. 438,516, April, 1940.—Crude marl is treated with $H_2SO_4$ under pressure at at least 110°. M.Ho.

## Chemistry and Physics

**Adsorption error in the determination of gaseous densities and the adsorption of gases on vitreous silica.** G. A. R. HARTLEY, T. H. HENRY, AND R. WHYTLAW-GRAY. *Trans. Faraday Soc.*, **35**, 1452–61 (Dec., 1939); *Science Abs.–A*, **43**, pp. 14–15 (Jan., 1940).—An experimental study of the adsorption of a series of gases on clean surfaces of vitreous silica is described. Comparison with the results obtained by Moles shows that the adsorption of even easily liquefiable gases on silica is, for the majority of gases, much smaller than that on glass surfaces. As a result of this investigation it is believed that the uncertainties due to adsorption effects in determinations of compressibilities, coefficients of expansion, and densities of gases could be reduced to negligible proportions by the use of silica vessels. The results also confirm the reliability of the limiting pressure method for comparing exact molecular weights of gases with the silica buoyancy microbalance. H.K.R.

**Breakdown of thixotropic structure as function of time.** RUTH N. WELTMANN. *Jour. Applied Physics*, **14** [7] 343–50 (1943).—The thixotropic breakdown of structure with time of agitation was measured at different rates of shear on a number of pigment suspensions and on various oils in a rotational viscometer. The product of breakdown rate and time of agitation at any rate of shear was found to be a constant for each material. This "time coefficient of thixotropic breakdown" is independent of the rate of shear and is measured in absolute units, having the dimensions of viscosity (dynes sec. / cm.²). The time necessary to break the thixotropic structure to its minimum at a specified rate of shear was also found to be independent of the rate of shear applied while agitating. A.P.

**Colorimetric determination of carbon monoxide.** S. M. CHUMANOV AND M. B. AKSEL'ROD. *Zhur. Priklad. Khim.*, **11**, 1236–37 (1938); **12**, 1568–70 (1939).—Experiments were carried out for determining minute amounts of carbon monoxide in air. Ferric salts as well as salts of palladium and gold are reduced by carbon monoxide. The reduction is slight without a catalyst but reaches almost 50% in the presence of silica gel. The divalent iron formed by the action of 0.02 mgm. of CO per liter can be detected with potassium ferricyanide. F.S.M.

**Compound merwinite ($3CaO \cdot MgO \cdot 2SiO_2$) and its stability relations within the system CaO–MgO–$SiO_2$ (preliminary report).** E. F. OSBORN. *Jour. Amer. Ceram. Soc.*, **26** [10] 321–32 (1943).—7 references, 5 figures.

**Concentration of hafnium. Preparation of hafnium-free zirconia.** EDWIN M. LARSEN, W. CONARD FERNELIUS, AND LAURENCE L. QUILL. *Ind. Eng. Chem., Anal. Ed.*, **15** [8] 512–15 (1943).—A satisfactory extraction of cyrtolite ore [approximately $R_3Y_2(Zr, Hf)(SiO_4)_{12}$] is obtained when two parts of concentrated sulfuric acid and one part of 200-mesh ore are heated to a maximum temperature of 210° to 220°C. and the resulting acid-soluble constituents are extracted with water. When acid solutions of dilute zirconyl-hafnyl sulfate and dilute phosphoric acid are simultaneously sprayed into a 10% sulfuric acid solution at 70° to 75°C., a dense, compact, and easily filterable precipitate is obtained. By the action of an ice-cold sodium hydroxide-sodium peroxide solution on a cold slurry of the phosphates and subsequent digestion at 70°C., an acid-soluble hydrate results. This step replaces the usual basic fusion or complex-ion formation as the intermediate step between fractionations. The conditions for the fractional separation of zirconium and hafnium by direct precipitation of the phosphates in dilute solutions were studied. By precipitating approximately 55% of the dissolved zirconium-hafnium oxide content of a sulfate solution, the percentage of hafnium oxide of a sample of the mixed oxides is raised from 13 to 93% in seven fractionations and from 59 to 97% in four fractionations. By treating the mother liquors from the precipitations in similar fashion, a sample of zirconium oxide whose spectrogram reveals no lines characteristic of hafnium is obtained. Illustrated. F.G.H.

**Detection of cadmium.** F. A. VAN ATTA AND W. L. WASLEY. *Jour. Chem. Education*, **18** [1] 31 (1941).—The separation of Cd from Cu in group II of the qualitative analysis scheme is discussed. Cd is identified by (1) conversion to the carbonate through the addition of $Na_2CO_3$

and (2) distillation of metallic Cd from the calcined carbonate through the addition of C. The production of a Cd mirror during distillation constitutes the test. The Cd is confirmed by a sulfide test. S.Z.

**Determination of iron in water. A modified colorimetric procedure.** FRANCIS J. HALLINAN. *Ind. Eng. Chem., Anal. Ed.*, **15** [8] 510–12 (1943).—H. describes a simple colorimetric thiocyanate method for the determination of iron in water, which is applicable in the presence of amounts of organic matter, sodium hexametaphosphate, or sodium pyrophosphate greater than are likely to be encountered. The test is not applicable in the presence of copper; in such instances it constitutes a qualitative test for this material. The color standards are stable for at least six months. F.G.H.

**Determination of metallic copper and cuprous oxide in commercial cuprous oxide pigments.** IRVIN BAKER AND R. STEVENS GIBBS. *Ind. Eng. Chem., Anal. Ed.*, **15** [8] 505–508 (1943).—Cuprous oxide is readily soluble, cupric oxide is slightly soluble, and metallic copper is very slightly soluble in cold, dilute, aqueous hydrochloric acid. The presence of hydrazine sulfate reduces any divalent copper entering solution and prevents reaction between metallic copper and cupric ion. The addition of potassium chloride prevents the precipitation of cuprous chloride from the very dilute hydrochloric acid solution. If the analysis is performed under an inert carbon dioxide atmosphere, the metallic copper and cupric oxide may be filtered off, dissolved in acid ferric chloride, and titrated with ceric sulfate. The total reducing power, the sum of the cuprous oxide and copper reducing equivalents, may be determined by direct solution of the sample in acid ferric chloride and subsequent titration under a carbon dioxide atmosphere with ceric sulfate. F.G.H.

**Determination of silica in the presence of molybdic acid.** A. R. TOURKY AND H. K. EL SHAMY. *Analyst*, **68** [802] 2–5 (1943).—Silica may be determined accurately in the presence of molybdic acid providing an appropriate excess of oxalic acid (3 to 5 gm. oxalic acid for 100 mgm. $MoO_3$) is used and the evaporation is carried out at a relatively low temperature (60° to 70°C.). With acid solutions or insoluble silicomolybdates, the color should be discharged (or the precipitate dissolved) in alkali hydroxide before the oxalic acid is added. B.C.R.

**Determination of sodium in the presence of molybdenum.** C. H. HALE. *Ind. Eng. Chem., Anal. Ed.*, **15** [8] 516–17 (1943).—Molybdenum interferes with the determination of sodium by the zinc uranyl acetate method by the formation of a precipitate with the reagent. This interference can be overcome by the formation of a complex of molybdenum with citric or tartaric acid. F.G.H.

**Determination of the width of pores of ceramic and glass filters by the air–liquid and liquid–liquid systems.** R. SCHNURMANN. *Kolloid Z.*, **87** [2] 127–28 (1939); abstracted in *Physik. Ber.*, **21** [5] 471 (1940).—While it is maintained that the formula of Cantor is applicable only for equilibrium conditions, the bubble pressure method can also be used under changing outer pressures. In this case, however, the greater the increase in velocity of exterior pressure, the smaller are the radii of the pores. M.Ha.

**Electrokinetic behavior of Carborundum.** A. J. HAM AND W. HODGSON. *Trans. Faraday Soc.*, **38** [6–7] 217–21 (1942).—To obtain absolute electrokinetic measurements at a surface, Carborundum particles were used. They were easily purified and freed from grease. The apparatus and the technique whereby surface conductivity errors were eliminated are described. Carborundum is proposed as a suitable standard for such electrokinetic measurements because (1) reproducible results are obtained, (2) it behaves electrokinetically as an insulator, and (3) over the voltage range used, mobility and applied voltage are linearly related. Electrophoretic mobility vs. pH curves for Carborundum and metadinitrobenzene are discussed. F.J.H.

**Isotopes as indicators.** C. ROSENBLUM. *Jour. Chem. Education*, **17** [12] 566–70 (1940).—R. reviews the use of isotopes for purposes of "tagging" molecules in a reaction. Three cases are discussed in which (1) the isotope ratio of the contaminated system remains constant, (2) the isotope ratio is immaterial, and (3) the isotope ratio changes. Organic and inorganic reactions in which isotope "tags" were used are discussed. S.Z.

**Metals.** L. BRAGG. *Endeavour*, **2** [6] 43–51 (1943).—As a corollary to a new demonstration, by means of air bubbles floating on soap solution, of the behavior of stressed single metal crystals, the yield stress is estimated reasonably correctly. It is $(ns)/t$, where $n$ = the approximate elastic coefficient, $s$ = the distance between neighboring atoms (from X-ray crystal analysis), and $t$ = the size of differently orientated metal single crystals, obtained from X-ray spectra line broadening. L.R.B.

**New methods for the separation of nickel and cobalt from iron and nickel from cobalt.** B. S. EVANS. *Analyst*, **68** [804] 67–70 (1943).—Cobalt and nickel are separated as chlorides from the iron and titrated together with standard KCN and $AgNO_3$. Nickel is titrated as before after cobalt is converted into a cobaltic cyanide. B.C.R.

**Physics in 1942.** T. H. OSGOOD. *Jour. Applied Physics*, **14** [2] 53–68 (1943).—O. reviews experiments and theories concerning (1) crystals and photons, (2) thermal diffusion, (3) the nucleus, (4) the neutrino, (5) cosmic rays, (6) X-rays, and (7) active nitrogen. A.P.

**Polarographic method of analysis: I, General review of electroanalytical methods.** O. H. MULLER. *Jour. Chem. Education*, **18** [2] 60–72 (1941).—Work in 1922 on electrolysis with a dropping mercury electrode led J. Heyrovsky to the development of the polarographic method of analysis. This method is based on the electrolysis of a minute fraction of a solution in a cell containing one small easily polarizable electrode and one large non-polarizable electrode. The voltage necessary for the electrolysis is dependent not only on the nature of the reacting substance but also on the concentration. Precipitation reactions, oxidation-reduction reactions, and acid-base titrations can be carried out in a quantitative manner. Great simplicity and speed are claimed for the method. Other electroanalytical methods are discussed. **II, Apparatus.** *Ibid.*, [3] 111–15.—A history of the development of the apparatus from polarography is given. At present the following equipment is required: an e.m.f. source, a polarizing unit, a cell, and a galvanometer. Specifications for the equipment and its assemblage and manipulation are detailed. **III, Fundamentals of quantitative analysis.** *Ibid.*, [4] 172–77.—The current development in the electroanalytical cells is a function of numerous factors that must be evaluated for the proper application of polarography. These factors are discussed. **IV, Fundamentals of qualitative analysis.** *Ibid.*, [5] 227–34.—The theory of qualitative analysis as applied to electroreduction and oxidation processes is discussed. **V, Applications.** *Ibid.*, [7] 320–29.—Substances suitable for polarography must be electroreducible or oxidizable within the range of the electrode (dropping mercury electrode potential range, $E_{sce}$ = 0.6 to 2.6 volts), and they must be in true solution and stable for the duration of the experiment. The optimum concentration range is $10^{-4}$ to $10^{-3}$ molar. The volume of solution required is 5 to 20 cc. The practical limit of the method is 1 μgm. Limitations of the method and its application to organic and inorganic problems are discussed. S.Z.

**Potentiometric titration of molybdate in presence of silicic or phosphoric acid.** A. R. TOURKY AND H. K. EL SHAMY. *Analyst*, **68** [803] 40–44 (1943).—Methods for the potentiometric titration of molybdate with titanous chloride or chromous chloride are described. B.C.R.

**Separation of chromium by means of mercury cathode.** R. C. CHIRNSIDE, L. A. DAUNCY, AND P. M. C. PROFFITT. *Analyst*, **68** [807] 175–80 (1943).—Conditions necessary for the separation of chromium over a mercury cathode were investigated. High current density, elevated temperature, concentrated solution, and minimum acidity tended to increase the rate, while rotation of the anode or the addition of reducing agents tended to prevent deposition. Alkali metals are without effect. When the concentration of ammonium sulfate is such as to inhibit,

partially or completely, the deposition of chromium, small additions of nickel or very small but critical amounts of silver may be added to the electrolyte to overcome this difficulty. B.C.R.

**Structural precipitates: the silicate garden type.** T. H. HAZELHURST. *Jour. Chem. Education*, **18** [6] 286–89 (1941).—The "silicate garden" is an example of a precipitate in which the units aggregate to form a more or less rigid type of structure. It was first reported in 1684. The phenomenon depends on the immediate formation of a barrier which isolates the reaction. Subsequent fracture of the structure by change in volume of the precipitate or by osmotic pressure permits the extension of the structure. Four distinct types of silicate garden precipitates are mentioned: (1) tubular growths led by an air bubble, (2) lumpy or tubular growths produced by alternate formation and rupture of a somewhat elastic membrane, (3) growths supported by a glass tube, and (4) open tubular structure without air bubbles. The coloring of the precipitates is discussed. S.Z.

**Upper limit of temperature.** C. ROSENBLUM. *Jour. Chem. Education*, **17** [8] 438 (1940).—The upper limit of temperature is calculated from the equations $PV = RT$ and $PV = {}^1/_3\ mnu^2$ by assuming that all of the molecular energy goes into heat. From these calculations, $T = 3.58 \times 10^{12}$ for the hydrogen atom. This temperature is much higher than either the surface or the internal temperature of known stars. **Discussion.** F. G. BRICKWEDDE. *Ibid.*, [11] 543.—Rosenblum was in error in using the mass term in his equation as equal to the mass at rest. He should have made a correction for velocity of the particle thus: $m = m_0 \sqrt{1 - u^2/C^2}$. There is no upper limit of temperature, because of the manner in which the temperature scale was selected. The question is discussed in detail. S.Z.

**Viscosity of pure liquids: I, Nonpolymerized fluids.** R. M. BARRER. *Trans. Faraday Soc.*, **39** [2–3] 48–59 (1943).—The Arrhenius equation, $\eta = \eta_0 e^{-E_A/RT}$ ($E_A$ is energy of activation), was used in a study of the viscosity of many pure liquids. In some, $E_A$ was constant; in others, $E_A$ varied with temperature. Variations of $E_A$ and $-\log \eta_0$ with chain length in some homologous series are discussed. Consistent relationships are found between $-\log \eta_0$ and $E_A$ and between $-\log \eta_0$ and $E_A/T$. The data approximate the general viscosity function, $3.71 \times 10^{-3}\ e^{0.23 E_A/RT}$ poises. **II, Polymerized ionic melts.** *Ibid.*, pp. 59–67.—Glasses and polymerized ionic melts are characterized by high viscosity, $\eta$, and a large Arrhenius energy of activation, $E_A$. For silicate and other glasses the following relation was found between $-\log \eta_0$ and $E_A/T$: $-\log \eta_0 = 0.115\ E_A/T\ (1 + 0.00152\ E_A/T)$. Over the range $8.6 < E_A/T < 100$, it is nearly a straight line with slope and intercept different from those for molecular and nonpolymerized fluids. This was explained in terms of the zone theory. In many flow systems it was possible to estimate the number of degrees of freedom involved in each zone and the total energy per activated degree of freedom necessary for flow to occur, as well as the zone volume. The calculation was carried out for typical glasses, liquid metals, simple ionic melts, and apolar and polar or hydroxyl bonded fluids. F.J.H.

**Water: some interpretations more or less recent.** G. S. FORBES. *Jour. Chem. Education*, **18** [1] 18–24 (1941).—F. reviews the more recent developments on the constitution of water and water solutions. The hydration of the ions in solution is discussed. S.Z.

### SEPARATE PUBLICATIONS

**Heat Transfer Bibliography.** Compiled by F. C. VILBRANDT ET AL. *Bull. Virginia Polytech. Inst., Eng. Expt. Sta. Series*, No. 53, 72 pp. (March, 1943). Price 25¢.

**Letter Symbols for Heat and Thermodynamics Including Heat Flow. American Standard Z10.4-1943.** Published by the American Society of Mechanical Engineers, New York, 1943. 20 pp. Price 55¢.—This standard consists of an extensive revision of the present American Tentative Standard for Symbols for Heat and Thermodynamics approved and published in February, 1931. The initial draft of this revision was prepared by a subcommittee of the Sectional Committee on Letter Symbols and Abbreviations for Science and Engineering (Z10) appointed in April, 1926.

### PATENTS

**Ferric oxide and its preparation.** B. F. BUTLER. U. S. 2,330,553, Sept. 28, 1943 (Dec. 17, 1938).—The cyclic process of making ferric oxide from nitric acid solutions which comprises decomposing the nitric acid by adding metallic iron thereto and thereby forming ferric nitrate and oxides of nitrogen and of iron, reconverting the oxides of nitrogen to nitric acid by reaction with water and oxygen and returning the nitric acid to the reaction chamber to react with more iron, and separating and recovering the ferric oxide from the reaction mixture.

**Manufacture of calcium antimonate.** C. J. HARBERT AND L. A. BATEMAN (Harshaw Chemical Co.). U. S. 2,329,161, Sept. 7, 1943 (Nov. 4, 1940).—A process of making calcium antimonate comprising heating a batch essentially consisting of $Sb_2O_3$ and a substance of the class consisting of CaO, $Ca(OH)_2$, and $CaCO_3$ in an oxidizing atmosphere at temperatures not substantially exceeding 656°C. until a major portion of the antimony has been oxidized beyond the trivalent state and then heating at a temperature above 656°C. until the reaction is substantially completed.

**Siliceous catalysts which retain their shape.** GEWERKSCHAFT MATHIAS STINNES. Belg. 438,373, April, 1940.—Crude clay is added to the paste from which the catalyst is made before it is shaped into grains or lumps. M.Ho.

**Smelting antimony ore.** CHARLES O'KEEFE. U. S. 2,330,307, Sept. 28, 1943 (March 14, 1942).—The method of producing antimony from antimony trioxide which comprises mixing antimony trioxide with carbon, forming a crucible of hot slag composed of dehydrated sodium sulfate and sodium chloride, filling the crucible with the mixture of carbon and antimony trioxide, sealing the filled crucible with the hot slag, and then heating the crucible and its contents until the crucible melts to form a flux which reacts with the impurities.

## General

**Cleaning of air and gas by thermal repulsion: I.** SAMUEL C. BLACKTIN. *Jour. Soc. Chem. Ind.* [London], **58** [11] 334–38 (1939).—The effect of heated solid bodies of rod form in producing at normal pressure a dust-free region around them is termed a radiometer action. B. tested various sources of heat and different types of dust-repelling apparatus. Electrical heating (by conduction) and hot-water heating gave comparable results. A peripheral hot-wire repulsor was developed which served well as a dust repellor. In an electrically heated apparatus with air originally containing, at 18.4°C., 90,800 dust particles per cc., the contents were 52,000 at 38.5°, 25,760 at 55°, 17,080 at 74°, and 3200 particles at 85.3°. An apparatus using hot-liquid heating gave, with air originally containing 56,000 particles per cc. at 14°, 17,100 at 29°, 4300 at 44°, 3100 at 55°, and no particles at 81°. **II.** *Ibid.*, **59**, 153–54 (1940).—B. gives data showing the efficiency of a perforated repulsor 0.25 in. in diameter and 0.375 in. in length. An efficiency of 94% was obtained with different smoke dispersions at a rate of 4 cu. ft. of air per hr. with the extremely low resistance of 1 mm. water gauge for the perforated repulsor of 0.2 sq. in. of effective area; the resistance can be further lowered by increasing the length of the repulsor. A trial of an unperforated repulsor gave decidedly inferior results, because the black-body radiation from the perforated device contributes materially to

its efficiency. See "To . . . . ," *Ceram. Abs.*, **19** [6] 150 (1940). F.S.M.

**Colloidal coal-oil fuel for power-plant boilers.** ANON. *Nat. Engr.*, **47** [6] 376 (1943).—A mixture of pulverized coal and oil can be used in many industrial boiler plants. This report was made by the U. S. Bureau of Mines after a trial of colloidal fuel in a Philadelphia boiler plant. Pulverized bituminous coal (40%) and Bunker C fuel oil (60%) were mixed and fed to a furnace using a steam atomizing type of burner. The test revealed some difficulties, but none was serious. M.R.

**Crystalline compounds observed in water treatment.** CARROLL E. IMHOFF AND LOHR A. BURKARDT. *Ind. Eng. Chem.*, **35** [8] 873–82 (1943).—The crystalline compounds encountered in water treatment which have been identified by X-ray diffraction and the polarizing microscope are reviewed and enumerated. Conditions of formation of natural minerals, synthetic minerals, and identical compounds in water treatment are discussed. A boiler scale corresponding to the mineral acmite ($Na_2O \cdot Fe_2O_3 \cdot 4SiO_2$) is reported, and conditions for its formation are described. All compounds identified by the authors have been by the X-ray powder diffraction method. Illustrated. F.G.H.

**Design of foundations for stacks and towers.** V. O. MARSHALL. *Petroleum Refiner*, **22** [8] 251–68 (1943).—The principles involved in the design of stack and tower foundations of the types commonly required in the erection of refinery equipment are discussed. The same principles apply to either stacks or towers. In the case of stacks, the brick lining is a variable load, corresponding to and requiring the same treatment as the liquid insulation, etc., in a tower. R.G.C.

**Dust sampling.** COAL DUST RESEARCH COMMITTEE. *Science & Art of Mining*, **53**, 217–18 (1943).—Sampling methods using the konimeter, settling trays, and the Soxhlet thimble filter were tested. Conclusions are as follows: (1) The konimeter is useful for visual comparison. (2) Tray tests give the rate of dust fall but no data on health hazards. (3) The Soxhlet thimble filter method is the most suitable for general use in a mine. W.D.F.

**Electrical equipment maintenance.** C. W. FICK. Presented at meeting of the Cincinnati Electrical Maintenance Engineers Assn.; abstracted in *Nat. Engr.*, **46** [8] 494–96 (1942).—Maintenance engineers carry the heavy responsibility of keeping the war industries geared to high production. The job is divided into three important parts: (1) preventing interruptions due to accidents to or failure of electrical equipment in the plant, (2) keeping the duration of such interruptions to an absolute minimum, and (3) planning for increased loads or extensions of electrical service. M.R.

**Experiences of a Czechoslovakian ceramist.** K. ZIMMER. *Ceram. Ind.*, **41** [2] 66, 68, 70 (1943).—Z., who has had wide experience in the European pottery industry, makes comparisons of the ceramic industries in various countries. H.T.

**Eye protection and civil defense.** J. D. SPOONER. *Optician*, **106** [2733] 21–23 (1943).—Protection of the eye against injury requires an appliance which excludes flying particles, fire, glare, dust, smoke, and gas; is wearable with a gas mask; permits corrective spectacles; provides clear, unobstructed vision; and is simple and foolproof in operation. The most satisfactory solution seems to be either adjustable metal cross apertures or a glazed metal frame fitted with eyecups. A.P.

**Filters for dust work.** COAL DUST RESEARCH COMMITTEE. *Science & Art of Mining*, **53**, 133–34 (1942).—A combination of filter and water spray is used. Lessing rings, coke, and coal were tried for filtering, and coal between $^1/_8$ in. and $1^1/_4$ in. was selected. A box having a double wall was made, and the coal was put in the double wall. Outside dimensions are $2^1/_2$ x $2^1/_2$ x $4^1/_4$ ft., and it is covered with wire mesh. A spray in the outlet blows against the air current. W.D.F.

**New Murray Hill Laboratory of Bell Telephone Laboratories.** F. L. HUNT. *Jour. Applied Physics*, **14** [6] 249–57 (1943).—Construction features of the new Murray Hill, N. J., unit of Bell Telephone Laboratories are described and illustrated. A.P.

**Packaging research.** ANON. *Chem. Trade Jour.*, **111** [2883] 181–82; [2889] 290 (1942); **112** [2909] 183 (1943).—With the financial support of the Department of Scientific and Industrial Research and of interested companies, fundamental research into packaging is to be carried out as part of the research program of the Printing and Allied Trade Research Assn. The suggested program of research is as follows: (1) to determine the protection afforded by various packaging materials against outside conditions; (2) to improve the protection afforded by packaging materials; (3) to obtain maximum hygienic protection for the package; (4) to obtain the most suitable design of package from the viewpoint of strength; (5) to obtain the most effective closure; (6) to obtain improved methods of cutting and creasing; and (7) to obtain optimum results from automatic packaging machinery. The problem of odor will also be considered. L.R.B.

**Patents today.** D. I. MAYNE. *Chem. & Eng. News*, **21** [5] 287–93 (1943).—M. presents a practical up-to-the-minute discussion of the situation on patents and, particularly, their present relationship to the war effort. Illustrated. F.G.H.

**Physics in industry.** E. U. CONDON. *Jour. Applied Physics*, **13**, 663–65 (1942).—Organized research in physics is essentially a product of the last quarter of a century. The National Research Council fellowships established soon after World War I, supported at a cost that was absolutely trifling, have done more for the development of American research science than any other single thing. In the 1920's, research in fundamental physics expanded by leaps and bounds. Industrial physics also expanded in the electronic industries, but it was characteristic of that period that industry and physics were not closely associated. During the 1930's, there was a shameful and inadequate development of our natural resources in scientific talent and inventiveness. The scientific method was attacked as antisocial, and support of scientific research was curtailed. Finally it was realized that bringing the newest results of physics into industry was fruitful and stimulating in turn to the science. This war has brought American physicists to an understanding of how much their science can contribute to the welfare of the people. Industry is recognizing the debt it must repay by fostering more basic research in its own laboratories and by working in close cooperation with the universities. A.P.

**Plant engineer's experience with industrial accidents.** GEORGE F. FARLEY. *Better Enameling*, **14** [7] 15–17 (1943).—The results of a 12-year accident record indicate that 90% of the accidents might have been prevented. In many cases management has been guilty of negligence in correcting potential sources of accident. B.C.R.

**Prevention of silicosis: experimental investigations on the action of certain nonsiliceous dusts and silica in the origin and development of silicosis.** C. NAESLUND. *Jour. Ind. Hyg. & Toxicol.*, **22**, 1–30 (Jan., 1940).—The nonsiliceous dusts tested were coal, soda, calcium hydroxide, aluminum hydroxide, metallic aluminum, iron oxides, and magnesium oxides. The siliceous dusts included quartz, colloidal and amorphous silica, leptite, cement, and glass. Comparative subcutaneous tests were made to determine the differential effects of the dusts before proceeding with the inhalation tests. The chemically indifferent dusts, such as coal and glass, have no apparent effect on the silicotic process. Silicosis and anthracosis appear to develop quite independently with no sign of mutual collaboration. Alkaline dusts produced irritation and necrosis in the lungs with very slight fibrotic response and no sign of effect on toxicity of the silicon. These latter dusts produced marked susceptibility to pulmonary infections and may account for deaths from "acute silicosis" in human beings who have inhaled quartz and alkaline dusts. Pure metallic aluminum considerably retarded the rise of silicosis and also had an inhibitive effect on the development of fibrotic reactions. Iron and magnesium dust also possess a slight inhibitory action on silica. The addition of cement dust brought about a slight decrease in the effect

of silica but appeared to increase the risk of pulmonary infection with fatal issue at a relatively early stage (as do other alkaline dusts). F.S.M.

**Role of engineer in air sanitation: general survey.** E. B. PHELPS. *Proc. Amer. Soc. Civil Engrs.*, **65**, 1475 (Nov., 1939).—In studying methods of air sanitation, the engineer must know the possibilities of good engineering practice and combine with this a knowledge of the physical, chemical, bacteriologic, physiologic, and toxicologic properties of the special types of impurities with which he has to deal. F.S.M.

**Stokers promote wartime economies in fuel utilization.** T. F. J. MOFFETT. *Heating & Ventilating*, **40** [8] 38–40 (1943).—The underfeed stoker principle is conducive to economy. It supplies coal as it is needed and furnishes the correct amount of air to burn the fuel supplied. The stoker industry hopes that the basic principles of good combustion will become better understood. These are as follows: (1) a sufficiently high temperature for combustion, (2) sufficient air for combustion, (3) thorough mixing of air and combustible at the proper temperature, and (4) furnace volume and sufficient length of flame. M.R.

**Stratification of gases in coal-fired boilers.** J. M. DRABELLE. *Nat. Engr.*, **44** [6] 416, 419 (1940).—Combustion processes of furnaces in operation are accurately recorded by means of motion pictures. Eastman Kodak and Corning Glass assisted in planning for the photographic work. The equipment is described. The films provide many facts pertaining to gas stratification, unconsumed gases, and incomplete combustion of gases and act as a yardstick for comparing methods of fuel firing. M.R.

**Visually handicapped [employees] in industry.** E. LESTER. *Optician*, **105** [2732] 420–21 (1943).—In evaluating the prospective employee's visual ability to perform a certain job, other visual functions in addition to acuity should be tested. These include binocular vision, muscle balance, color discrimination, depth perception, and peripheral vision. A.P.

**Waste-heat boilers and turbo-blowers in conjunction with coke-fed central gas producers.** H. WINTER. *Gas & Wasserfach*, **85**, 169–74 (1942); abstracted in *Fuel Research Intelligence Section, Summary for Two Weeks Ending May 8 and 15, 1942*, p. 274; *Woodall-Duckham Tech. Press Rev.*, No. 859, p. 4 (June 3, 1942).—Possibilities in the production of steam by the waste heat from coke-fed central gas producers with complete jacket boilers were investigated, and comparisons were made of the necessary heating surface. The steam consumption of the producer plant and the excess steam available are discussed, together with the most suitable steam pressure for driving the turbines for air and gas blowers.

SEPARATE PUBLICATION

**If It's Piping, Contact Flori.** Published by the Flori Pipe Co., St. Louis, 1943. 64 pp.—This booklet covers the various ways in which piping can be used and lists present market prices for every conceivable kind and size of fabricated piping. It will be useful for handy reference. It may be obtained without charge from Department R-8, Flori Pipe Co., St. Louis, Mo.

PATENTS

**Improved flotation apparatus.** SOCIÉTÉ GÉNÉRALE DES MINERAIS (SOC. ANON). Belg. 436,190, Sept. 30, 1939.—The pulp leaving the separator passes through an ascending and then a descending course. A by-pass is provided to prevent the accumulation of particles (having a higher density) at the bottom of the tank. The levels in the tank and in the by-pass are controlled by the same assembly. M.Ho.

**Improved procedure for the manufacture of glazed ceramic products.** N. S. GARBISCH. Belg. 436,841, Nov. 30, 1939.—A mixture of silica and powdered glass is heated to a temperature exceeding the fritting point of the glass but below the fusion point of the mixture. In this state the products are compressed and glazed while still hot. After the glaze fuses, the bodies are refired. M.Ho.

**Improvement in the production of ceramic products.** N. S. GARBISCH. Belg. 436,641, Nov. 30, 1939.—The clay is mixed with a powdered siliceous product derived from alkali treatment of the waste obtained in polishing glass with abrasive sand. M.Ho.

**Preparation of ceramic materials.** GEWERKSCHAFT KERAMCHEMIE-BERGGARTEN. Belg. 440,206, Feb., 1941.—Before molding, chemicals are added to the mix which react with the gases evolved in the decomposition of the mix to yield nongaseous compounds and thus prevent blistering. M.Ho.

**Procedure and apparatus for classifying loose materials according to their density.** F. KRUPP A.-G. Belg. 436,412, Oct. 31, 1939; addition to Belg. 418,891.—A liquid whose density equals the average density of the particles to be classified is caused to flow through a trough. At its end the stream is divided into several smaller streams, each of which, with the material it carries, is collected in a separate channel. M.Ho.

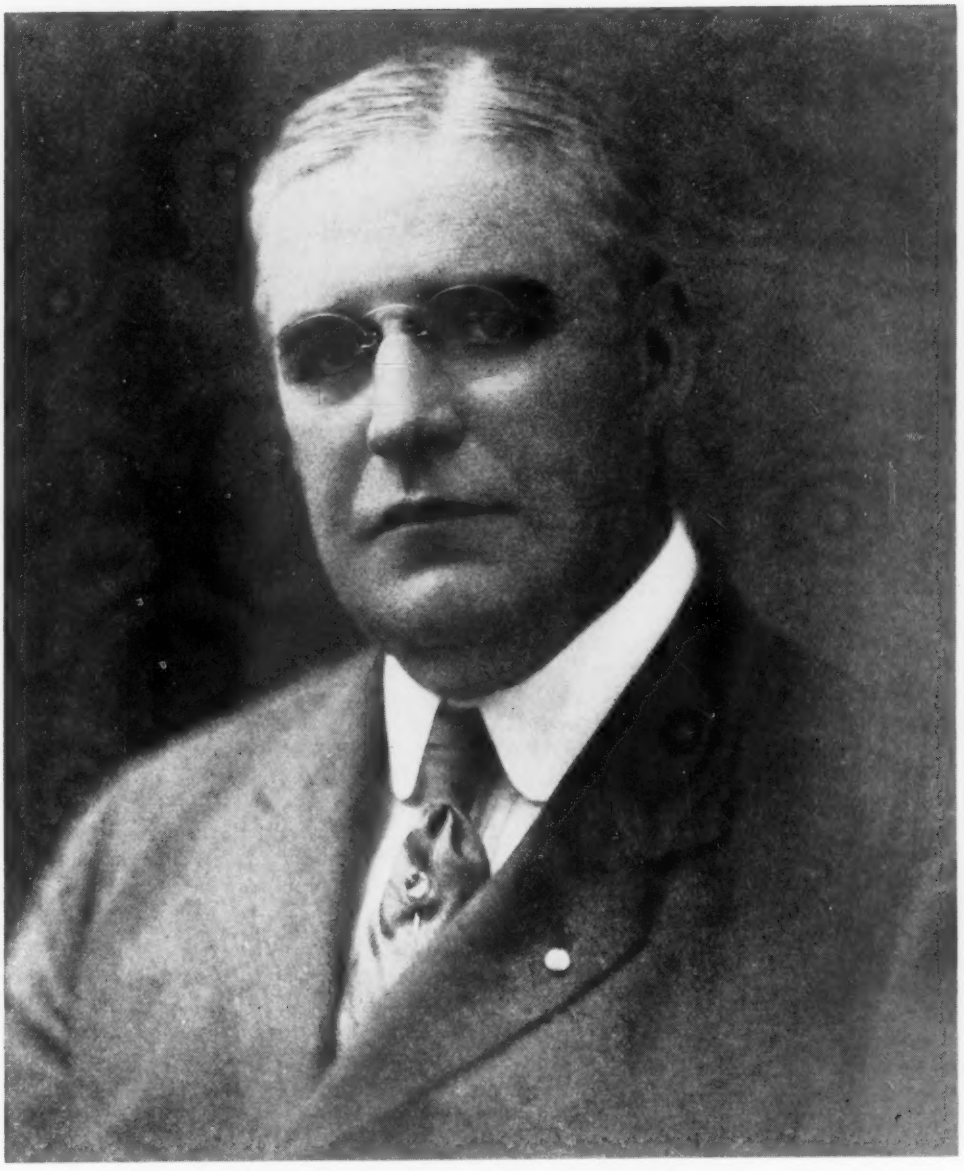
**Separating minerals.** F. L. SMIDTH & Co., AKTIESELSKAB. Belg. 434,840, July 8, 1939.—The mineral mixture is suspended in a liquid. The fraction of the suspension containing particles smaller than 15 microns is separated by means of a centrifuge, and the rest of the suspension is processed by flotation. This method of separation is particularly suitable for minerals used in cement. M.Ho.

Individualism Is a Clearly Defined Quality
Only in Him Who Recognizes
Himself as a Social Animal
Industries Began and Have Been Advanced
By Individuals Cooperating with Others

*Be Sure to Participate in the 46th Annual Meeting*
*Hotel William Penn, Pittsburgh, April 2–5, 1944*

# THE BULLETIN SECTION

Volume 22 November 15, 1943 Number 11



WILLIAM CAMERON SPROUL

# WILLIAM CAMERON SPROUL*

## First President of the American Refractories Institute
## One of the Organizers of the General Refractories Company

William Cameron Sproul was born at Andrews' Bridge, Colerain Township, Lancaster County, Pennsylvania, on September 16, 1870, the son of William Hall and Deborah Dickinson (Slokom) Sproul.

His middle name was given to him in honor of General Simon Cameron, for so many years a dominant factor as politician and statesman not only in Pennsylvania but in the Nation. It is said that his maternal grandfather, Squire Samuel Slokom, of Sadsbury Township, Lancaster County, who was a great admirer of Senator Cameron, suggested the name and that the future Governor of Pennsylvania would have been named Simon Cameron Sproul had the Squire had his way. But his mother was decided in the opinion that the child should bear his father's name, William.

His lineage is ancient and honorable. For many generations his ancestors were prominent in the life and achievements of Delaware County; so far back, in fact, as when, previous to 1789, what is now that county was still Chester County, its growth and population having justified the separation into two counties.

Nicholas Newlin, a grandfather six generations removed, was a member of William Penn's Provincial Council and was a Quaker and friend of the Founder. He was also a member of the Pennsylvania assembly. Nathaniel Newlin, son of this ancestor, was a judge when the old courthouse at Chester was built, and a grandson of the latter, another Nathaniel Newlin, occupied the same seat in the State Senate that the subject of this sketch filled, having been elected in 1794. The already referred-to maternal grandfather, Squire Slokom, was chairman of the Lancaster County Republican Committee for twelve years, so it will be seen that William C. Sproul comes to his political career naturally, from both sides of the house.

Likewise, it may be pointed out that for four generations the Sprouls have been ironmasters, so that we have a ready explanation of the bent for that business and the success in it attained by William C. Sproul.

Charles Sproul, who came from the County Tyrone, Ireland, in 1787, was a millwright and soon became a partner in a forge in Montgomery County. His son, James Sproul, an associate of the Colemans of Cornwall, Lebanon County, had forges and blast furnaces on the Octoraro and at his death in 1847 owned several thousand acres of land in western Chester County and eastern Lancaster County in connection with his Sadsbury Iron Works.

Governor Sproul's father, who was born in 1837 and was named for William Hall of Lebanon, his father's friend, followed the iron business in Lancaster County, in Upper Michigan and in Chester, nearly all his long life, and his sons, Everett and William Cameron, have made it their principal business, too.

His father was an officer of the Iron Cliffs Company, and eight years of the future Governor's early boyhood were spent in the busy little city of Negaunee, where the furnaces and the general offices of the corporation were located. An uncle by marriage, Thomas J. Houston, also lived there and was a commanding figure in the community. His energy and ability set a fine example for the lad, and Governor Sproul has often said that the patience of his father, of his grandfather, and of his Uncle Thomas in answering questions was beyond belief. Others who have known the three men give them credit for encouraging the accumulation of the wonderful store of information which the youth possessed.

About his sixth birthday, William C. Sproul was sent to a school kept by Mrs. Harris, in Negaunee, and a year later to a private school conducted by Miss Louise N. McIntyre, who came from Saranac, New York, and was an extraordinarily good teacher. This school, never so large as to require more than one teacher, occupied a room in a small building used as a lumberyard office in Negaunee, and here for five years young Sproul received the careful instruction of this painstaking woman. When he was eleven years old, he was studying algebra and French and was ready to enter the Negaunee High School. After a year there, during which time he helped edit and print *Our School*, the high-school periodical, the family returned to Pennsylvania, and six months were spent by the lad in the public school at Christiana, Lancaster County, the home of his grandparents. In 1883, his parents settled in Chester, the home of his forbears, and the lad entered the high school in that city.

He could have been graduated from the high school at sixteen, prepared to enter college, but he and his chum, William D. Pullen, now a leading merchant in Chester, decided they would stay with the old class through the normal course, so they qualified as teachers and received normal certificates upon their graduation in 1887. He entered Swarthmore as a freshman that fall.

Governor Sproul's career, chronologically, was as follows:

(1) At the age of eleven, with Fred Dougherty, a schoolmate, he printed his first newspaper, *The Amateur*, on a press which he kept always; the press had a chase $3^1/_2$ by $5^1/_2$ inches. In high school, he started *The Sun*, printed on this same press. He also contributed to the Chester High School paper, *Tribune*.

(2) At the age of fifteen, he was Chester correspondent for *The Philadelphia Press*.

(3) His college chum was Alexander Mitchell Palmer, who became a distinguished democrat.

(4) He and Alexander Palmer decided to join the weaker of the two literary societies, the Eunomian, to build it up to equal the then stronger society, the Delphics.

* Excerpts from The Story of William C. Sproul, Governor of Pennsylvania, by Henry Starr Richardson; pp. 7–10. Published by the Terrapin Club as a souvenir of the dinner given in honor of William C. Sproul on the evening of March 1, 1919, at the Manufacturers' Club, Philadelphia, Pa.

(5) In college, he edited the college paper, *Phoenix*, and through his editorials brought about a number of reforms and progressive changes which helped in the transition of Swarthmore from its old boarding-school chrysalis into the splendid college which it has become.

(6) While in college, he was correspondent for the *Chester Times* and several Philadelphia dailies.

(7) He was graduated from Swarthmore in 1891.

(8) He was married January 21, 1892, to Emeline Wallace Roach, daughter of shipbuilder John B. Roach.

(9) In March, 1892, he acquired a half interest in the *Chester Times*, and for several years gave to it his undivided attention.

(10) His son, John Roach Sproul, born January 30, 1895, attended Mercersburg Academy and Swarthmore and served in World War I as a First Lieutenant. His daughter, Dorothy, married Henry J. Klaer, vice-president of the Penn Seaboard Steel Corporation, October 7, 1914.

(11) He was elected to the Senate in 1896 at the age of twenty-six and was re-elected to serve six terms.

(12) In 1900, he and friends took out a charter for the Seaboard Steel Casting Company, of which he became president. In 1916, this plant was sold to the Penn Seaboard Steel Corporation.

(13) In 1903, he undertook the development of coal and timberlands in the Kanawha Valley in West Virginia and purchased control of the Coal River and Western Railroad, all of which was sold to the Chesapeake and Ohio Railway. He bought control in several traction companies in West Virginia, was active manager of them, and sold them.

(14) In 1909, he succeeded in having established the State Highway Department which took over the main roads.

(15) In 1910, he formed the firm of Fleitz and Sproul, fruitgrowers with two thousand acres planted in fruit.

(16) In July, 1911, with William A. Stanton, he organized the General Refractories Company with plants in Pennsylvania and Kentucky. He was the first president and later became chairman of the Board, the position he held at the time of his death.

(17) He and his associates acquired complete control of the Lebanon Valley Iron & Steel Company, a large bar iron and bolt and nut works.

(18) In 1912, Franklin and Marshall College, Lancaster, Pennsylvania, gave him the honorary degree of Doctor of Laws. In 1918, he received the same degree from the University of Pennsylvania. In 1915, the Phi Beta Kappa Society, University of Pennsylvania chapter, made him an honorary member.

(19) In 1915, he set about to establish a shipyard at Chester with Samuel M. Vauclain, head of the Locomotive Works, and Joseph Pew of the Sun Oil Company.

(20) He maintained holdings in railroads and several banks.

(21) He was elected Governor of Pennsylvania in 1918 by a plurality of 245,293.

(22) On the twentieth anniversary of his graduation from Swarthmore, he furnished the funds to build and equip an observatory.

(23) In 1925, he was elected first president of the American Refractories Institute.

(24) He died March 21, 1928.

(25) He is remembered in Pennsylvania for the development of the highway and school systems, forests and state parks, and for the revision of the banking and insurance laws.

(1943)

## THE GENERAL REFRACTORIES COMPANY*

Late in 1910, the Sandy Ridge Fire Brick Company, a small clay brick plant on top of the Allegheny Mountains in Centre County, Pennsylvania, was bought by William C. Sproul, William A. Stanton, W. I. Shaffer, Howard Longstreth, P. M. Sharples, John P. Crozier, Robert Wetherill, and T. Coleman du Pont. Mr. Stanton had formerly been connected with the Harbison-Walker Refractories Company, and it was he who interested Governor Sproul and his friends in this undertaking.

Governor Sproul and Mr. Stanton had been officers and some of the others were stockholders in the former Fayette Manufacturing Company which had sold out to the Harbison-Walker Refractories Company in 1901. The Fayette Manufacturing Company was unique in that it had introduced magnesite into the United States and had manufactured the first basic brick. These brick had been first produced at their Layton, Pennsylvania, Works. The business had grown so fast that a larger plant had been built on the water front at Chester, Pennsylvania. (This is the plant now operated by the Harbison-Walker Refractories Company.) Silica brick had been manufactured at Johnstown, Pennsylvania, and puddle-mill and beehive coke-oven brick had been manufactured at the Layton, Pennsylvania, plants.

Immediately following the purchase of the Sandy Ridge plant, the manufacture of magnesite and chrome brick, in addition to fire-clay brick, was undertaken. Shortly thereafter, the erection of a silica brickworks was started at Sarah Furnace, now known as Sproul, in Blair County, Pennsylvania. The Sandy Ridge Fire Brick Company was well known in the industry as a producer of high-grade fire-clay brick, particularly for use in blast furnaces and hot-blast stoves. A Sandy Ridge lining in a prominent Ohio River furnace endured a strenuous campaign of over nine years.

The following year, W. H. Wynn & Company, with a fire-clay brick plant at West Decatur, Pennsylvania, and the Olive Hill Fire Brick Company, with a fire-clay brick plant at Olive Hill, Kentucky, were acquired, and the interests were all merged in the General Refractories Company of West Virginia, chartered on July 7, 1911. The West Decatur plant of W. H. Wynn & Company had been built in 1900, and its output was highly regarded for general steelmill work in the Pittsburgh, Harrisburg, and Philadelphia districts. The Olive Hill plant of the Olive Hill Fire Brick Company had been built in 1895, and most of its output had been used for lining blast furnaces and hot-blast stoves in the South and Middle West. By this time, the silica brickworks at Sproul had been completed, and the young company offered consumers what was then a complete refractories service. This service was such that the demand for its products increased and it became necessary to expand.

The old Sandy Ridge Works was destroyed by fire and rebuilt with a larger capacity in 1912. In the same year,

* Submitted by L. J. Trostel.

the fire-clay brick plant of the Karthaus Fire Brick Company of Karthaus, Pennsylvania, was purchased. The Olive Hill plant, running at capacity on blast-furnace and hot-blast stove brick, made another plant in Kentucky necessary for mill brick, and a new works was built at Hitchins, Kentucky, in 1912 and started operating the last day of that year.

The manufacture of magnesite at Sandy Ridge, Pennsylvania, had moved right along, and owing to the uncertainty in the supply of raw materials, the General Refractories Company in 1914 bought the General Magnesite Company of Hisnyoviz, Austria-Hungary. Three days after the final payments were made in Budapest, the World War broke out and the Company officers who had negotiated the transaction had a precarious journey back to Philadelphia. This works at one time was behind the Russian lines and later was operated by the Austrians with Russian prisoners, but no magnesite was shipped to the United States. The American flag was flown over the works until the entrance of the United States into the War, and, fortunately, in the later rearrangement of Central Europe, Hisnyoviz was given to Czechoslovakia and the works remained the property of the General Refractories Company. After the War, owing to satisfactory arrangements for a permanent and steady supply of dead-burned magnesite, the General Magnesite Company of Hungary was sold to Austrian interests.

Anticipating the oncoming rush for refractories, and in the interests of its consumers, the General Refractories Company bought the Mt. Union Silica Brick Company, Mt. Union, Pennsylvania, in 1915 and started the erection of a Western silica brickworks at Joliet, Illinois. The Mt. Union Silica Brick Company had been an outstanding manufacturer of silica brick since 1901. The works was enlarged and remodeled, and its output was allotted to the manufacture of munitions and other war supplies. The new Joliet Works, the "last word" in silica brick plants, started manufacture in the fall of 1916 and its product, along with that of the Mt. Union and Sproul plants, enabled the General Refractories Company to do its share in helping the steelworks meet the tremendous emergency call for more steel.

During 1917, the Olive Hill, Kentucky, plant was destroyed by fire, and so serious was the loss of this capacity that Government priority orders were issued for steel and other materials, and in less than six months an enlarged and improved works was in operation. That same year, the Eagle Brick Works of Mill Hall, Pennsylvania, manufacturers of building brick, was acquired and hurriedly remodeled to manufacture high-grade fire-clay brick.

The General Refractories Company took advantage of the general rearrangements and readjustments that occurred after the close of the World War. The General Office was moved to Philadelphia, where the ownership of the Company was located. Research and Engineering Departments were established and obsolete equipment was replaced by the latest devices known to brick manufacturers, including the Company's own patented sizing machines. All plants and kilns were repaired, fenced in, and extensive clay and ganister acreage was bought and leased. Up to that time, approximately seventy-five per cent of the Company's business had been with manufacturers of iron and steel, and it was felt that a more general distribution of its products would be healthier.

With this in mind, the Company in 1922 purchased the Pennsylvania Fire Brick Company, the Hayes Run Fire Brick Company, and the Standard Refractories Company. It surrendered its West Virginia charter and on October 24, 1922, was granted a new perpetual charter under the laws of Pennsylvania. The Pennsylvania Fire Brick Company was located at Beech Creek, Pennsylvania, where it had been manufacturing fire-clay brick since 1901. Although some blast-furnace and hot-blast stove linings had been shipped, most of its product was sold for general purposes throughout Pennsylvania, New Jersey, New York, Canada, and the New England States. The Hayes Run Fire Brick Company also had been a manufacturer of fire-clay brick at Orviston, Pennsylvania, where the plant had been built in 1904. Its product was well regarded by consumers in Eastern Pennsylvania, New York, and the New England States. The Standard Refractories Company had been chartered in Pennsylvania in 1913 and had built a large silica brickworks at Claysburg, Pennsylvania. The acquisition of this plant, with its large capacity and its superior product, immediately placed the General Refractories Company in the forefront of manufacturers of eastern silica brick.

The business of the General Refractories Company had by this time become national in scope. More silica brick capacity was necessary, particularly for its customers in the Middle West. Larger and better facilities were needed for the manufacture of basic refractories. There was also a growing demand for high-alumina brick, manufactured principally from diaspore. The situation was met by the purchase in 1923 of the American Refractories Company, with plants at Rockdale and Danville, Illinois, and at Baltimore, Maryland, and the General Refractories Company became the second largest manufacturer of refractories in the world. The Rockdale Works on the outskirts of Joliet, Illinois, had begun to manufacture silica brick late in 1906. Although its product had been in general use throughout the Middle West wherever silica brick were indicated, it had been particularly fancied by engineers and builders of by-product coke ovens. The Danville, Illinois, plant, built in 1914 for the manufacture of silica brick, had for some time been making high-alumina brick, in which division of the industry it was one of the pioneers. The Baltimore Works, completed in 1917, was the largest and best-equipped plant in existence for the manufacture of magnesite and chrome brick and other basic refractories.

New and satisfactory negotiations were concluded which assured the General Refractories Company of adequate supplies of the highest grade American and foreign magnesites and chrome ores for years.

The General Refractories Company participated in the prosperity that industry enjoyed for some years. Its products were shipped into every state in the Union, as well as into Canada and Mexico. The Engineering and Research Departments were enlarged, improved methods of manufacture were devised, and new products were introduced. Tunnel kilns, particularly for the manufacture of fire-clay brick, had been erected by some manufacturers. Refractories of American manufacture were finding a ready market in the West Indies, South America, Asia,

and in parts of Europe. New and diversified industries were springing up in our own Far South and Southwest. Confronted with all this, it was again necessary for the General Refractories Company to move forward.

This it did through the purchase in 1929 of the Evens & Howard Fire Brick Company, with plants at St. Louis, Missouri, and the Stevens Pottery, Georgia, and in 1930 of the Kier Fire Brick Company, with plants at Salina and Childs, Pennsylvania. These acquisitions enabled the General Refractories Company to offer a complete refractories service to users all over the world. The St. Louis plant, embracing in its large equipment a modern tunnel kiln, had been manufacturing fire-clay brick since 1855, when, as a small unit, it had been the first one built west of the Mississippi River. The Stevens Pottery plant had been built in the kaolin fields of Georgia in 1860 and had been manufacturing fire-clay brick since that time. For many years, it had been almost the only source of supply for the Far South, and its story is of much historical interest. The original Kier plant at Salina, Pennsylvania, had been built in 1845 and had been one of the first in Pennsylvania. At the time it was taken over by the General Refractories Company it was probably the most complete and up-to-date plant in America for the manufacture of high-grade fire-clay brick. With large tunnel kilns, modern machinery, and coal and clay mines on the property, it was and is today a model brick establishment. The Childs, Pennsylvania, works of the Kier Fire Brick Company had been built in 1884 for the manufacture of fire-clay brick and silica brick, principally for use in beehive coke ovens. In recent years, it has confined itself to the manufacture of a unique silica brick from rock adjacent to the property. When such silica brick are indicated, there is no other to dispute its superiority.

During the depression, the manufacture of silica brick quietly spread into Southern Ohio. Fire-clay brick long produced in that section were improved and found ready markets at distant points. After careful investigation, the General Refractories Company decided to enter the field and did so by the purchase in 1939 of the Portsmouth Refractories Company. That Company owned and operated fire-clay plants at Oak Hill and Portsmouth, Ohio, and a silica brick plant at Portsmouth, Ohio.

Owing to the rapid expansion of business in the Southwest the General Refractories Company purchased the assets of the Malakoff Brick Company, Malakoff, Texas, in August, 1941, and converted this plant which had been engaged in the manufacture of facebrick into a fire-brick plant for serving the many Texas industries. In November, 1942, the plant at Malakoff was destroyed by fire. To reestablish a manufacturing unit in Texas, the Company is now building a modern tunnel-kiln fire-brick plant at Troup, Texas, close to a large deposit of high-grade fire clay previously located by the Company. Here will be manufactured high-duty and intermediate-duty fire-clay brick and mortars.

For years, the General Refractories Company has shipped basic, silica, high-alumina, superduty, and fire-clay brick and many specialty products to the copper, steel, cement, glass, and other industries of the Far West. Most of the requirements for fire-clay and silica brick have been supplied by plants in California, Oregon, Washington, Idaho, and Montana.

The rush of new construction, since the start of World War II, in the old and many new industries west of the Rocky Mountains necessitated large shipments of refractories from the East. The General Refractories Company felt the time had arrived to complete its chain of plants across the country. On May 15, 1943, the plants and assets of the Refractories Corporation of Los Angeles, California, were taken over. The modern and up-to-date plant had for some years been manufacturing silica, fire-clay, high-alumina, and sillimanite brick, glasshouse refractories, cements, and mortars, as well as warehousing basic brick and special products of the General Refractories Company. The Los Angeles management was retained and adjustments for improvement of products and increased capacity were made, thus assuring the Pacific Coast industries adequate refractories service.

The acquisition of these outstanding units placed the General Refractories Company in all producing fields. In the purchase and building of plants in Pennsylvania, Maryland, Kentucky, Georgia, Ohio, Illinois, Missouri, Texas, and California, the General Refractories Company acquired men experienced in the manufacture and application of refractories in these producing districts. Practical men working in conjunction with trained technicians of the Engineering and Research Departments have enabled the General Refractories Company to improve all of its regular products, develop new ones, and raise the quality of refractories in the entire industry. Its twenty-two plants located at strategic points in the states mentioned have a total capacity of 300,000,000 brick a year.

Well-established agencies handle the Company's products in Canada, Mexico, Cuba, Australia, the Philippine Islands, South Africa, and a number of countries in Europe and South America. Dealers in all of the principal cities of the United States offer a complete refractories service of General Refractories Company products.

Thus, in a little over thirty years, the General Refractories Company has built up an organization with almost unlimited supplies of raw materials, modernized manufacturing facilities, a diversity of standard, special, and patented products, with research and engineering service, that fulfills its Grefco trademark and its slogan, "A Complete Refractories Service."

## Research Development of the General Refractories Company

After the acquisition of the assets of the American Refractories Company in 1923, the production capacity of the General Refractories Company had grown so large and its products so diversified it was realized that some coordinated plan was necessary to control the high quality of the numerous special-purpose brands the Company now manufactured and to provide for the continuing development of new products to cope with special operating conditions arising in the consuming industry due to gradual changes in fundamental furnace design and operation.

Shortly thereafter, a capable Research and Testing Department was established. The nucleus for this organization was a small unit located at the Rockdale Silica Works in Joliet, Illinois, which had served the three plants

of the American Refractories Company. This unit was expanded and installed in a new and larger laboratory building erected in 1926 and adjoining the Baltimore, Maryland, Works. As the Company continued to expand and the work of the Department grew in importance, further enlargement of the laboratory building was made, and today it represents one of the most modern and up-to-date refractories research and testing units either in this country or abroad. This laboratory is equipped with a complete pilot plant for manufacturing various types of refractories by different processes; physical testing equipment and numerous high-temperature furnaces for performing all of the standard A.S.T.M. tests on refractories, as well as special tests devised by the staff; a chemical laboratory for performing silicate analyses; and an optical laboratory containing petrographic apparatus, an interferometer, and an X-ray diffraction machine.

Experimentation has always been carried out on three fronts: in the laboratory, in the plant, and finally in the field by actual trials under the user's observation in his own furnaces. Each of these phases has its own particular advantages and limitations. Numerous patents have been granted as a result of the investigations of the Department. Product and process development have proceeded hand in hand. The various patents granted cover improvements in the field of silica, kaolin, fire-clay, superduty, diaspore (high-alumina), sillimanite, magnesite, and chrome refractories. Probably the most notable is the Ritex process for the manufacture of unburned magnesite and chrome brick. This process involved the first application to unburned basic brick of the principles of "gap" grain-sizing, high molding pressure, and the use of multiple bonding agents for all temperature ranges. The advantages of this process with its rapid rate of production, lower costs, and better quality of products are well known to refractories users. The commercial importance of the process is attested to by the phenomenal growth in production of these new products.

Much of this growth in production of Ritex brick is due to their use in applications where conventional magnesite and chrome brick had previously been unsatisfactory. The following are typical of the new uses developed within six years after the introduction of Ritex:

*Iron and Steel Industry:* The exposed sections of the basic open-hearth steel furnace such as front and back walls, uptakes, and even including portions of the roof, sidewalls of electric-arc furnaces, hot metal mixers, and the lower sections of heating furnace sidewalls. *Rock Products Industry:* The hot zones of rotary kilns producing Portland cement clinker, high-grade lime, or dead-burning dolomite and magnesite. *Nonferrous Industry:* Suspended roofs and exposed walls of reverberatory mat furnaces smelting nickel concentrates and copper ores and concentrates, roofs and exposed walls of reverberatory furnaces refining copper and copper-bearing scrap, roofs and walls of both reverberatory and electric furnaces melting and casting copper. *Glass Industry:* Checkers, port sidewalls, and crowns of glass tanks producing a wide variety of glass.

In these new applications, Ritex brick last longer and cost less than the silica, clay, superduty, high-alumina, and sillimanite refractories previously used. These accomplishments are attributed to the special properties peculiar to Ritex brick and close collaboration with furnace operators in utilizing these properties.

Factors in the success of the Research Department have been adherence to the policy of applying fundamental engineering and technical knowledge as soon as it is available, searching out and developing new techniques of processing and testing, coupled with close attention to the practical performance of refractories in consumers' furnaces.

# DETERMINATION OF THE WORKABILITY FACTOR FOR A PLASTIC REFRACTORY *

By G. B. Cunningham, Lieutenant Commander, United States Naval Reserve, and J. F. Kelly

Abstract

A report is given of studies conducted to select a plastic refractory suitable for Navy use. A method of measuring a workability factor has been developed.

## I. Introduction

A material was found that, when tested in the Naval Boiler and Turbine Laboratory, had certain desirable properties. This same material, purchased under a proprietary requisition for experimental purposes, was tested in an actual boiler installation and gave excellent results. The present plastic refractory specification developed by this Laboratory was revised around those properties of this material which were shown to be desirable in the laboratory test. A number of manufacturers stated that they could not meet the proposed revision, but when they were told that one manufacturer had a material superior to the proposed specification, they all went to work, and some of those who said they could not meet the changes are now on the approved list. This new specification was not issued until four manufacturers had developed a plastic that could meet its requirements.

## II. Description of Plastic Refractory

A brief description of the use of a plastic refractory and its installation in Naval boilers shows why "workability" is so important to the Navy. This refractory material is used primarily in that part of the furnace front which is immediately adjacent to the burner cones. A typical arrangement of the oil burners and the section through these

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burners is shown in Fig. 1. In new construction, the brickwork is usually installed a month or more before the boiler is ready for firing, but it is recommended that the plastic installation be delayed as long as possible. The general method of installation is as follows:

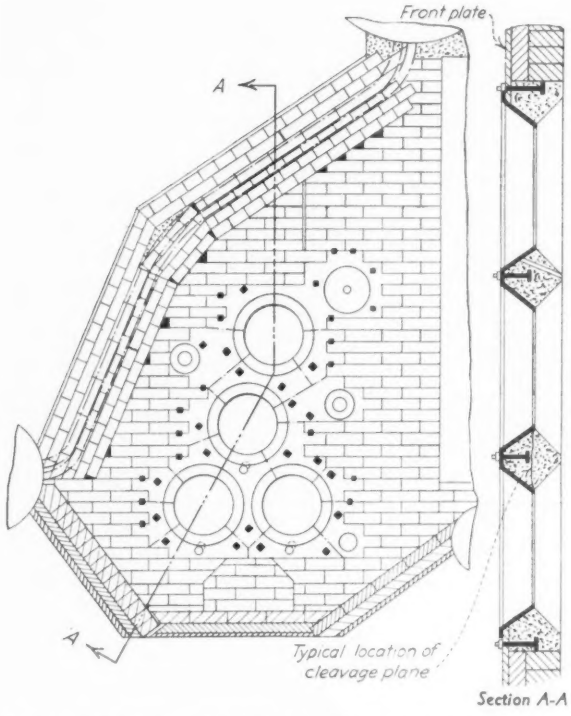


FIG. 1.—Typical refractory installation of boiler front wall.

(*a*) Pound the plastic in a vertical plane to prevent preformed cracks parallel to the hot face. (The plastic must be *well pounded*. This last point is so important that it cannot be overemphasized.) The lower portion of the plastic is built up to the line of the lower burner cones, and the forms are secured in place. The angle of these forms is slightly less than that desired when the installation is complete. This building up and the pounding around each cone form is continued until the entire wall is installed.

(*b*) The forms are removed, and a sweep centered by the burner barrel is used to bring the cone to the desired angle concentric with the burner. As may be seen in Fig. 1, some thin central ligaments remain, and if the plastic does not possess good workability, trouble will start before the boiler is fired for the first time.

(*c*) The surface is vented on $1^1/_2$-in. centers with a $^3/_{16}$-in. rod tapered to a blunt point in the last half inch. The venting goes entirely through the plastic to the uncalcined diatomaceous earth next to the casing. This precaution is taken to allow for the escape of any steam that might be formed when the boiler is first fired.

(*d*) The entire surface of the plastic is roughened by stippling with a wire brush or a hacksaw blade.

Plastic is also installed is this same manner around peepholes and where odd shapes would be required.

To secure good service from plastic refractory, the method of firing is important, as well as the material and the installation. The boiler should be fired within 24 hr. of the time when the plastic installation is completed. If this is impossible, the entire surface should be kept moist by covering it with damp burlap bags or similar material until just before the first lighting-off. When the boiler is fired, the No. 1 burner with a small-sized tip should be lighted for 15 min. At the end of this time, No. 2 burner should be lighted and the No. 1 burner secured. This same procedure should be continued for 6 hr.; all of the burners should be rotated on a 15-min. schedule. The firing rate should then be increased gradually over a period of 6 hr. so that the boiler will be at full power at the end of the second 6-hr. period. The boiler should then be steamed at full power without any interruption for an additional 6-hr. period. This procedure, which has been prescribed as the ideal method, cannot be followed for new construction or when a boiler is needed for almost immediate service. In the first case, the boiler may be steamed off and on for several days, weeks, or even months before it is operated at a steaming rate that will bond the plastic. When this hit-and-miss procedure is followed, the original installation has in practically all cases given poor results. In the second instance, a boiler must be on the line at full power within 2 hr. of the time that the last boilermaker has left the furnace. This fast firing is the main reason for venting plastic. Boilers have been fired, however, on this fast schedule at the Laboratory, and the service received from this installation has been practically as good as when the boiler is fired on the gradual schedule previously outlined.

## III. Workability

The method used for determining the workability and the limits assigned to this factor have never, within the recollection of the writers, been questioned. The industry as a whole may not agree with this part of the specification, but the fact that it has not been questioned shows that it is accepted as a fair and just method. This method has been adopted by the American Society for Testing Materials for determining workability.

What is workability as measured by the method now used by the Navy in its plastic refractory specification 32R1 (INT) of July 15, 1941? It is the ability of the material to be readily pounded into place, without shattering, and to occupy the space intended without slumping during the period between installation and firing. The question "What is workability?" could be discussed at length, but it is ventured that whatever would be said would in one way or another influence one or more of the properties just mentioned. The definition of workability as given here is admittedly broad (if it can be called a definition).

As workability was to be included in the specification for plastic refractory, a way to measure this property had to be found, and the method adopted had to give reproducible results. The workability test, although it involved quite a bit of work at the Laboratory, was not developed by "long and painstaking research and development." Attempts were made originally to measure workability by pounding plastic refractory into complicated shapes. A number of difficulties were encountered, primarily the personal element factor. Further development work resulted in the adoption of the present method, the mechanics of

which can best be described by the following paragraph from the present specification:

"Workability: 300 gm. of the test material shall be placed in a steel cylinder, 2 in. in diameter, the inside surface of which is finished smooth. The material shall be rammed under a standard sand rammer (Fig. 2) by 20 drops (10 from each end) of the weight or by any suitable means of applying 20 drops of a 14-lb. weight from a height of 2 in. The molded sample thus formed shall be extruded from the cylindrical mold, its length measured to the nearest $^1/_{32}$ in., and subject to 3 drops of the weight. The reduction in length caused by 3 drops of the weight upon the unsupported molded sample, expressed as percentage of its original length, shall be reported as the workability factor. This factor shall be the average obtained on 3 samples of the material."

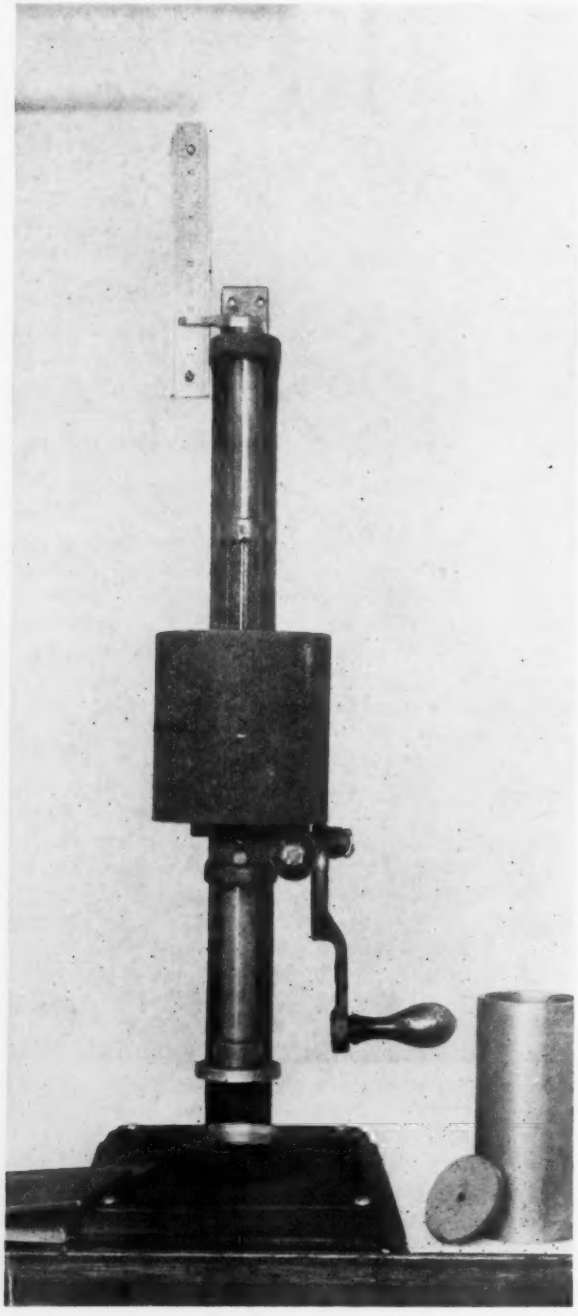

FIG. 2.—Standard sand rammer.

The machine used is that adopted by the American Foundrymen's Association as a sand rammer.

After the preliminary development of the present test, the primary points to be investigated were (1) the quantity of material to be used, (2) the number of tamps to be given to the supported and unsupported sample, and (3) the limits that would be set on the change of height. The quantity of material and number of tamps to be given to the supported sample were selected to give a density similar to that of the material as installed; it is surprising to note the wide variation that can be introduced by a small change in the number of tamps applied to a specimen while it is supported. This laboratory work finally had to be combined with installation and actual service results on the material itself, as service is the real criterion.

It has been interesting to watch and review the results of thousands of workability tests conducted since this method of determination was adopted. Over one hundred tests conducted since the issuance of the present specification have been reviewed, and the outstanding feature has been the reproducible workability factor determined on the products of one or more companies, while other companies showed a wide variation. For example, 7 samples of manufacturer A have been tested since the issuance of this specification, and the average workability factor of all of the samples was 22.81%; the high workability was 26.4 and the low was 20.8%. The high and low figures were from early shipments received from this manufacturer, and, if they are disregarded, the workability values for the remaining 5 samples only varied from 22.2 to 22.8%. The high and low workability factor for any 3 samples from the same shipment was extremely small, i.e., the least variation was from 21.6 to 22.8% and the greatest variation was from 21.4 to 23.8%. As measurements were made to the nearest $^1/_{32}$ in., this allowed for a maximum error of 1.25%, if the original sample measured $2^1/_2$ in. high. The 3 samples were also selected from different parts of the package, i.e., one from near the top, one from the center, and one from near the bottom. These tests show that close control was exercised over the manufacturing process and selection of clays.

Manufacturer B presents a different picture. Seventeen samples of this manufacturer were examined; the results between each 2 successive shipments varied considerably, and any 5 successive shipments showed as much inconsistency as the entire 17. In other words, one or more of 5 consecutive samples were near the limits. The workability on these 17 samples varied from a low of 14.5 to a high of 33.7% and averaged 23.25%. The variation between the three tests on any one shipment also varied from a low of 2.2 to a high of 8.9%. This shows a poor selection of clays or poor control over the manufacturing process. Within reasonable limits of error, workability can be predicted by the feel of the material, but this cannot be written into a specification.

Good service results have been obtained from the material of manufacturer A, whereas the plastic of manufac-

turer B seldom steamed for more than 150 hr. before repairs had to be made to the furnace of the test boiler.

Much information on moisture content versus workability is being collected, and at some time in the not-too-far-distant future it may be possible to draw some conclusions from these data, but this is uncertain. The data will be reviewed and checked as to an individual manufacturer's product rather than as a whole. Any change in clays will also be considered, so that it may be impossible to evaluate moisture content unless identical clays and manufacturing processes are used.

The Navy had difficulty with plastic installations until a short time ago. Complaints have not been so frequent during recent months, but the opportunity for further improvement still exists. Additional limits have been placed on modulus of rupture and linear change. The modulus of rupture must be 100 lb. per sq. in. at 1500°, 200 lb. per sq. in. at 2000°, and 300 lb. per sq. in. at 2552°F., and it must increase with increasing temperature from 1500° to and including 2552°F. The present permanent change specification is as follows: The material shall not exceed +1 or −2% at any temperature from 230° to 2552°F., and the differential expansion and/or shrinkage shall not vary more than 0.75% between any two temperatures from 230° to 2552°F. These two requirements were put into the specification as the result of a practical investigation carried out at the Laboratory on the material of manufacturer C. Mechanical strength and permanent linear change were determined on this material at numerous temperatures from 230° to 2552°F., and the values obtained were well within the limits that are in the latest plastic specification. The general results from this laboratory work were just what the present specification states, i.e., the modulus of rupture increased with increasing temperature, and the linear change, after the original drying shrinkage at 230°F., was slight and, in this case, all in one direction. This material gave excellent results when installed in a test boiler that was abused in every possible way; it was, however, properly installed. The material of manufacturer D was then investigated. It had a mechanical strength of 800 lb. per sq. in. at 2000°F. and 400 lb. per sq. in. at 2552°F., and the permanent linear change characteristics varied from −2% at 2000°F. to +1% at 2552°F. To explain the failure of D's product (when installed in a test boiler) as opposed to C's, the temperatures existing in the plastic front of the furnace were investigated. The hot-face temperature adjacent to the burner cones as close as can be determined is approximately 2500°F. With the normal temperature drop in a plastic refractory, the temperature range of 2000° to 2500°F. existed in the first few inches in which cleavage planes (Fig. 1) were developing; 2 to 3 in. of the hot face of manufacturer D's product were thus allowed to fall into the furnace. As a result, this 3% differential expansion and/or contraction in manufacturer D's product resulted in the development of a cleavage plane. As plastic refractory installed in Naval boilers in the last few months has not had this differential shrinkage-expansion characteristic and the service has been far superior to that obtained previously, it is felt that in the near future it will be proved that these characteristics were contributory.

There is still room for improvement. For instance, it might be advantageous to include a permanent linear change and modulus of rupture at 2912°F., and the thermal expansion characteristics and hot modulus of rupture. It is only natural that these should be specified, as Naval refractory materials must withstand a temperature of 3000°F. in certain parts of the boiler where plastic refractory is used. Any change, however, will be made only after laboratory and service results have been correlated.

### IV. Work Factor

The present Specification 32B2*c* for Fire Brick includes a work factor which is used to arrive at a service cost. This work factor, in the case of Class B brick, includes P.C.E., weight, and spalling loss. A work factor involving these and possibly other characteristics could be assigned to the plastic refractory. The development of such a work factor would require considerable time and would involve much research and investigation to determine what properties should be included and what weight should be given to each factor. The inclusion of the work factor in the plastic specifications would allow the manufacturer of a superior product to receive a slightly higher price for his material. When the cost of installation of plastic refractory is considered, it is realized that the material giving the longest service will undoubtedly be the cheapest in the long run for the Navy. The actual cost of material and installation is not the only factor to be considered, as weight should be given to the availability of the boilers of Naval vessels for full power steaming, particularly at the present time. What is wanted now is "the longest possible service."

Naval Boiler and Turbine Laboratory
Philadelphia, Pennsylvania

# A STUDY OF THE TALC MINERALS IN STEATITE BODIES*

By John W. Lennon and Arthur S. Watts

Abstract

A study of (1) the fired properties of a variety of talcs both alone and in a steatite body and (2) the effect of different sources of alumina on steatite bodies.

### I. Introduction

Why is one talc satisfactory in a steatite body and another talc unsatisfactory? To answer this question, a study of the maturing temperature, firing range, and shrinkages of many types of talc, talc bodies, and plastics was undertaken. Other properties were also studied to a lesser degree.

The talc trials were prepared by adding 12.5% of a starch solution (25 gm. of starch dissolved in one pint of distilled water) and mixing to uniformity in a mortar.

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Five-gram samples of this material were weighed out and pressed at 3000 lb. per sq. in. in a brass slug mold on a Carver laboratory hydraulic press. The slugs produced were 16 mm. in diameter and approximately 13 mm. thick.

For steatite body mixtures which contained some plastic bond, the starch solution was unnecessary and 8% of distilled water was substituted.

When the slugs were dry, they were fired in a Globar electric furnace, the temperature being increased 500°F. per hour up to 120°F. of the predetermined maturing temperature of the body, and then finished in a temperature rising 60°F. per hour. Temperatures were determined by standardized thermocouples, and the rate of temperature increase was controlled by a Wheelco Capacitrol with an automatic attachment. After firing, the shrinkages were determined by micrometer measurements; the absorptions were determined by weighing, boiling two hours, cooling in water overnight, and reweighing after removing excess water with a damp cloth.

## II. The Investigation

Thirty-four analyzed talcs were obtained and tested for fired absorption, shrinkage, color, texture, refractoriness, and vitrification range. These talcs have been grouped on the basis of decreasing CaO content and each group has been arranged on the basis of decreasing $Al_2O_3 + Fe_2O_3$ content (see Table I).

TABLE I

CHEMICAL ANALYSES OF TYPICAL SPECIMENS OF TALC

| Talc | Ignition loss | $SiO_2$ | MgO | CaO | $Al_2O_3$ | $Fe_2O_3$ | Total $R_2O_3$ |
|---|---|---|---|---|---|---|---|
| 1 | 7.92 | 59.83 | 23.89 | 6.66 | 0.29 | 0.35 | 0.64 |
| 2 | 3.85 | 59.10 | 28.60 | 5.46 | 0.15 | 0.27 | 0.42 |
| 4 | 4.30 | 62.65 | 27.05 | 3.20 | 0.48 | 0.27 | 0.75 |
| 5 | 5.47 | 59.35 | 30.37 | 3.34 | 0.47 | 0.23 | 0.70 |
| 6 | 3.25 | 64.10 | 26.40 | 3.80 | 0.20 | 0.19 | 0.39 |
| 10 | 6.20 | 60.75 | 31.00 | 0.82 | 0.58 | 0.28 | 0.86 |
| 14 | 7.50 | 58.65 | 32.30 | 0.10 | 0.60 | 0.32 | 0.92 |
| 15 | 6.05 | 58.45 | 31.30 | 0.01 | 2.25 | 1.10 | 3.25 |
| 22 | 5.40 | 61.40 | 30.64 | 0.01 | 0.70 | 1.14 | 1.84 |
| 29 | 5.43 | 61.05 | 31.10 | 0.01 | 0.60 | 1.00 | 1.60 |

## III. General Conclusions on Talcs

The chief effect of lime is to shorten the firing range. All high-lime talcs fire white, thereby suggesting a bleaching action, but most high-lime talcs are low in iron content. A comparison, however, of the colors of talc No. 5 and talc No. 10 (white and light tan gray, respectively) suggests some bleaching influence of lime.

In opposition to this theory, talc No. 1 is extremely high in lime and low in iron yet fires to a light tan. Talc No. 2, which is similar to talc No. 1 in lime and iron content, also fires white. The difference apparently is in the MgO: $SiO_2$ ratio and ignition loss. Talc No. 1 contains more uncombined $SiO_2$ and the ignition loss is higher, thereby suggesting the presence of carbonates or some other difference in mineralogical composition in the two talcs.

It has been assumed that lime not only narrows the firing range but lowers the maturing temperature. This is not always true. At 2500°F., talc No. 5 with 3.34% CaO has 9.3% absorption, whereas talc No. 22 with 0.01% CaO has 2.27% absorption.

The influence of alumina on the character of a talc should be predicted by reference to the $MgO–Al_2O_3–SiO_2$ equilibrium diagram; $Al_2O_3$ from any source acts as a flux with talc. Talc No. 15 has 2.25% $Al_2O_3$ and reaches zero absorption at 2450°F. No other talc of the thirty talcs studied was glossy at this temperature. The vitrification range, however, was not reduced. The iron content of talc No. 15 is 1.10% and should resemble talc No. 29 when fired. Talc No. 15, however, fires to a uniform tan gray and is not speckled like talc No. 29. This is probably due to the action of the $Al_2O_3$ which promotes the solution of the iron and its uniform distribution.

The MgO content has a marked effect on the refractoriness of a talc. Talc No. 14 has a MgO:$SiO_2$ ratio of 32.30:58.65; otherwise it resembles talc No. 29 with a ratio of 31.10:61.05. This suggests that in talc No. 14 some MgO is present in other than talc form, possibly as $MgCO_3$. The refractoriness of talc No. 14 increases markedly, as evidenced by 7.8% absorption at 2650°F. when talc No. 29 has 1.67% absorption. Thus there is a certain relationship between chemical composition and the firing behavior of talcs and probably a much more definite relationship between their mineral compositions and their firing behavior.

## IV. Investigation of Talcs in a Standard Steatite Body

The talcs were incorporated in the following body: talc 76, clinochlore 19, and eyrite 5%. Clinochlore is similar to talc in mineral appearance but has a composition of $SiO_2$ 28.64, $Al_2O_3$ 25.19, MgO 32.89, $Fe_2O_3$ 0.61, $K_2O$-$Na_2O$-CaO 0.00, and ignition loss 12.87%. Eyrite is similar to talc in chemical composition but also contains small amounts of $Na_2O$ and fluorine. Its physical characteristics are similar to bentonite. Its chemical analysis is $SiO_2$ 59.77, MgO 27.46, $Al_2O_3$ 0.49, CaO 0.45, $Na_2O$ 2.73, F 5.35, and ignition loss 4.00%. By its aid the body possesses the necessary plasticity for molding without the use of starch or other plastic.

The standard body when prepared with talc No. 29 possesses good molding properties, good firing range, and good electrical properties.

## V. General Conclusions on Bodies

In general, the characteristics of the bodies are similar to those of the talc employed. The high-lime talc narrows the firing range; the high lime-low iron talcs produce bodies of white color but highly crystalline. All bodies with other properties similar to the body containing talc No. 29 possess a speckled appearance preceding vitrification, when they become a uniform gray color. The body containing talc No. 14 with the high MgO content is more refractory and is almost pure white.

The effect of alumina is not exactly the same in the bodies as in the talcs. For example, talc No. 15 became vitreous at a lower temperature than the other talcs but body No. 15 required a slightly higher temperature for vitrification. Talc No. 15 has the same firing range as standard talc No. 29, but body No. 15 has a narrower firing range than body No. 29.

The standard body chosen may not be adapted to all talcs, although whatever affects a talc probably will affect a body containing that talc.

### VI. Study of Source of Alumina in the Steatite Body

In the preceding body studies, clinochlore was the source of alumina because of its similarity in other respects to talc. As clay is the normal source of alumina in steatite bodies, a comparison was made, using both a high-alumina secondary kaolin and a ball clay as the source of alumina. No detailed study was made on the relative values of these clays as plasticizers, their use being considered as sources of alumina. The talc used was talc No. 3.

For this study, four series of bodies were made:

(1) Clinochlore was increased from 5 to 30% at the expense of talc with 5% eyrite constant. The most promising body in this series has the composition talc 80, clinochlore 15, and eyrite 5%; it reaches zero absorption below 2400°F. and is not deformed at 2500°F.

(2) Georgia kaolin was increased from 5 to 30% at the expense of talc with 5% eyrite constant. The most promising body in this series has the composition talc 90, Georgia kaolin 5, and eyrite 5%; it reaches zero absorption at 2250°F. and is not deformed at 2450°F.

(3) Georgia kaolin was increased from 5 to 20% at the expense of talc, omitting eyrite from the formula. The most promising body in this series has the composition talc 90 and Georgia kaolin 10%; it reaches zero absorption at 2300°F. and is not deformed at 2500°F.

(4) No. 4 Kentucky ball clay was increased from 5 to 20%, omitting eyrite from the formula. The most promising body in this series has the composition talc 90 and No. 4 Kentucky ball clay 10%; it reaches zero absorption at 2350°F. and is not deformed at 2500°F.

The most promising body developed in this study has the composition talc 90, Georgia kaolin 5, and eyrite 5%. It has the lowest maturing temperature combined with maximum firing range, indicating that the eyrite lowers the maturing temperature 50°F. As only one kaolin and one ball clay were studied, this cannot be considered as indicating the definite superiority of kaolin over ball clay as a constituent of steatite bodies, but it does indicate advantages of clays over clinochlore in regard to maturing temperature and firing range.

None of the bodies in this study were tested electrically and therefore it is not known whether they are equal or superior to the base body in which clinochlore was employed and which showed excellent electrical properties.

### VII. General Conclusions

(1) High lime-low iron talcs have a narrow firing range, fire white, and are highly crystalline.

(2) High-alumina talcs have a lower maturing temperature.

(3) High-magnesia talcs have a higher maturing temperature.

(4) The effects of these variations in talc composition are less apparent in bodies than in the talcs fired alone.

(5) A general idea of suitability of a talc for use in steatite bodies can be obtained from the chemical analysis, but some idea of the mineral impurities present in commercial talcs would also be useful.

(6) The firing range of steatite bodies is still the most serious problem of the manufacturer, and, although this may be controlled to some extent by choice of the talc employed, the necessity of adding clay, feldspar, or some other source of alumina and silica makes the problem more involved.

(7) The extent to which various talcs may be blended to advantage and the effects of blending clays in steatite bodies would be valuable information.

(8) The beneficial effect of eyrite as both a plastic and an auxiliary flux suggests that a study of auxiliary fluxes in steatite bodies may disclose helpful information.

Department of Ceramic Engineering
Ohio State University
Columbus, Ohio

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# A STUDY OF BODIES IN THE CLINOENSTATITE FIELD OF THE $MgO$–$Al_2O_3$–$SiO_2$ SYSTEM*

By John O. Semmelman and A. S. Watts

Abstract

A study of (1) the effect of additions of $SiO_2$ and MgO to a steatite body and (2) of eyrite, a talc mineral containing fluorine, used as a plasticizer.

### I. Introduction

One of the problems most frequently encountered in the high-frequency insulator industry is the extremely short firing range of the talc minerals. Another undesirable characteristic of these minerals is the irregular firing shrinkage which makes it difficult to fire insulators to the exact dimensions required.

If bodies possessing a longer firing range could be found, great accuracy in firing would not be required and production costs could be decreased accordingly. Furthermore, the rigid size specifications for steatite insulators cause a large number of rejects due to inaccurate size. Dies for forming the insulators may be made in any size, but the ware must shrink evenly on firing to ensure a finished product within the dimensional allowances.

Desirable electrical properties are found only in the clinoenstatite field of the magnesia–alumina–silica system; hence it was decided to search this field for longer firing ranges and uniform shrinkages. Sierra Snow, a relatively pure California talc, was chosen as one material. Kaolin suggested itself as a source of alumina and plasticity. Its use, however, involves high shrinkages, so it was discarded in favor of clinochlore, another high-alumina mineral.

In the search for plastic agents which could be added in

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small quantities so as not to detract from the electrical properties of the insulator, an auxiliary plastic such as bentonite seemed indicated. Bentonite, however, contains a definite iron content, hence a similar material, eyrite, was used, as it fires to a pure white color, has a composition similar to talc, and is doubly desirable as its firing would probably result in the formation of clinoenstatite.

From such a study of the field of clinoenstatite, the writers hoped to find general tendencies toward compositions which would possess satisfactory electrical properties and better-than-normal firing behavior.

## II. Method

Batches of the desired composition were weighed and mixed in a rubber mortar with a porcelain pestle, 10% of water by weight was added, and the mixing was continued. Individual batches were weighed out of the mortar and dumped into a mold for pressing. The mold was shaken slightly to level the material to be pressed. Then the plunger was inserted and pressure was applied by the Carver press to equal 3000 lb. per sq. in. At least ten pellets were made of each composition.

After drying, the pellets were fired in a Globar furnace. The furnace temperature was raised 500°F. per hour until within 120° of the final firing temperature. The firing was then culminated with a two-hour soaking period, during which time the temperature was increased at the rate of 1°F. per min.

On removal from the furnace, all pellets were inspected for color and adhesion to the silicon carbide slab on which they were fired, shrinkage was measured, and each pellet was weighed, boiled in water for two hours, allowed to stand in water overnight, wiped with a damp cloth, and reweighed. The gain in weight was reported as per cent absorption.

The minerals employed and their analyses are as follows:

Sierra Snow (Innis, Speiden & Company)

| | (%) | | (%) |
|---|---|---|---|
| $SiO_2$ | 57.25 | MgO | 29.50 |
| $Fe_2O_3$ | 1.10 | $TiO_2$ | 0.08 |
| $Al_2O_3$ | 1.90 | Ignition loss | 4.20 |
| CaO | 2.35 | | |

Clinochlore (Consolidated Feldspar Corporation)

| | (%) | | (%) |
|---|---|---|---|
| $SiO_2$ | 28.64 | MgO | 32.89 |
| $Fe_2O_3$ | 0.613 | $Na_2O$ | 0.00 |
| $Al_2O_3$ | 25.19 | $K_2O$ | 0.00 |
| CaO | 0.00 | Ignition loss | 12.87 |

Eyrite (M.S.) (F. E. Schundler & Company)

| | (%) | | (%) |
|---|---|---|---|
| $SiO_2$ | 59.77 | MgO | 27.46 |
| $Fe_2O_3$ | 0.026 | $Na_2O$ | 2.73 |
| $Al_2O_3$ | 0.49 | F | 5.35 |
| CaO | 0.45 | Ignition loss | 4.00 |

## III. Study of Clinochlore and Sierra Snow Talc Alone and with Additions of Eyrite

Clinochlore, owing to its composition, would undoubtedly form a considerable amount of clinoenstatite; talc on firing also forms clinoenstatite, which is desirable because of its electrical properties. The behavior of eyrite on firing was unknown; the amount, therefore, was kept low.

Twelve batches were made as prescribed in Section II. One pellet from each batch was fired at each of a series of seven temperatures, viz., 2400°, 2450°, 2500°, 2550°, 2575°, 2600°, and 2650°F.

## IV. General Conclusions

Within the temperature range studied, clinochlore shows promise as a steatite constituent. It provides a source of alumina, essential to the development of clinoenstatite, without the shrinkage characteristic of kaolin. It reaches zero absorption and tends to reduce the absorption of an otherwise porous body. It has a favorable gray fired color. It tends to stick to the slab on which it was fired, but in combination with a more refractory material this defect should be remedied.

Within the same temperature range, Sierra Snow talc has a uniform average shrinkage and a moderate absorption, although the absorption never reaches less than 0.4%, which is too high for use alone, and this is obtained only within a narrow temperature range. It has a favorable light-buff fired color.

The influence of eyrite on these two materials is important. When eyrite is added to clinochlore in amounts of less than $7^1/_2$%, its influence on the shrinkage and absorption at the various temperatures is hardly apparent in the firing shrinkage and absorption, although the molding properties are improved with even as little as $2^1/_2$% and with 5% are satisfactory for dry pressing. With additions of $7^1/_2$, 10, and 15% eyrite, the molding characteristics continued to improve and the temperature of vitrification decreased. Shrinkage did not change materially in the pellets that could be measured, but the tendency to stick to the slab was pronounced at 2500°F. and above when more than $7^1/_2$% eyrite was used. These mixtures, however, show the definite development of a vitreous body of the clinoenstatite character, and the firing range at zero absorption reaches 150°F. before fusion. With $7^1/_2$% eyrite added to clinochlore, the trials showed less than 1% absorption over a temperature range of approximately 175°F., but did not reach zero absorption until 2600°F.

When eyrite was added to Sierra Snow talc in amounts less than $7^1/_2$%, its influence was unfavorable except as a plastic to improve molding behavior. The shrinkage and absorption both increase slightly from 2400° to 2525°F., above which they decrease gradually up to 2650°F. and have about the same shrinkage and absorption as at 2400° F. Absorption never reaches zero. When eyrite was added to Sierra Snow talc in amounts of $7^1/_2$, 10, and 15%, its influence was erratic, but 10% eyrite gave most favorable results. With this addition, the absorption shows a minimum of 2.01% at 2400°F. Shrinkage decreases and absorption gradually increases up to 2600°F., suggesting incipient bloating. None of the eyrite-Sierra Snow talc mixtures, however, showed any tendency to stick to the slabs on which they were fired, and hence it may be assumed that little or no liquid phase develops due to reaction between these two minerals.

From the evidence developed, the possibility of developing a steatite body of the clinoenstatite type, using clinochlore as a vitrifying agent, Sierra Snow talc as a refractory, and eyrite as a plastic, is promising.

Department of Ceramic Engineering
Ohio State University
Columbus, Ohio

# NOTE ON THE USE OF DIATOMITE AS A SOURCE OF SILICA IN CERAMIC GLAZES*

By Wendell P. Keith

Abstract

Diatomaceous earth, a hydrous form of silica, was substituted for flint in five different types of glazes. In each case, the use of diatomite improved the gloss and resulted in an off-white color.

## I. Source

Diatomite, commonly known as diatomaceous earth, is a hydrous or opaline form of silica. Of organic origin, it consists of the fossil remains of microscopic aquatic plants known as diatoms. These minute organisms thrive wherever there are suitable conditions of moisture, light, and food supply. Each tiny plant is enclosed in a siliceous envelope, and when the organism dies, it sinks to the bottom of the water where the organic matter is more or less decomposed. The siliceous case remains, and the accumulation forms a deposit. As diatoms live in fresh, marine, and brackish waters, deposits of diatomite are of corresponding origin. They exist mainly in horizontal beds formed in prehistoric lakes.

Deposits of varying composition are found widely but not extensively throughout the world. They exist in twenty-four of the forty-eight states. Although all vary in composition and commercial value, many are suitable for ceramic use.[1]

The diatomite used in this investigation was from the vicinity of Kittitas, Washington, and had the following composition: $SiO_2$ 91.0, $Al_2O_3$ 1.3, FeO 2.0, miscellaneous 0.5, and $H_2O$ 5.1%, making a total of 99.9%.

If diatomite is hydrous silica alone, it should fuse theoretically at the same temperature as cristobalite, viz., cone 32 plus. Owing to the impurities present and the small particle size, some diatomites fuse between cones 11 and 29. The Kittitas diatomite used in this investigation had a P.C.E. of cone 29 and the potter's flint had a P.C.E. of cone 32.[2]

## II. Procedure

Each glaze investigated was calculated for potter's flint and then recalculated for the diatomite. The glazes were prepared in a ball mill in the usual manner. Those containing diatomite required about 50% more water for equal fluidity, so for better comparison the samples were dipped at three different thicknesses. After drying, all glazes were fired to their respective cone in either an electric or an oil-fired kiln.

For the fritted glazes, the frit was fused in a gas-fired frit pot furnace and quenched in water. It was then finely ground with clay for the suspending agent and dipped and fired as the previous samples.

The formulas of the glazes investigated were as follows:

Soft lead glaze (cone 010)

| | | | | | |
|---|---|---|---|---|---|
| PbO | 1.0 | $Al_2O_3$ | 0.10 | $SiO_2$ | 2.00 |

Medium lead glaze (cone 1)

| | | | | | |
|---|---|---|---|---|---|
| PbO | 0.40 | | | | |
| $K_2O$ | 0.20 | | | | |
| CaO | 0.30 | $Al_2O_3$ | 0.35 | $SiO_2$ | 2.86 |
| ZnO | 0.10 | | | | |

Bristol glaze (cones 6–7)

| | | | | | |
|---|---|---|---|---|---|
| $K_2O$ | 0.33 | | | | |
| CaO | 0.33 | $Al_2O_3$ | 0.56 | $SiO_2$ | 3.20 |
| ZnO | 0.33 | | | | |

Porcelain glaze (cones 9–10)

| | | | | | |
|---|---|---|---|---|---|
| $K_2O$ | 0.30 | | | | |
| CaO | 0.70 | $Al_2O_3$ | 0.50 | $SiO_2$ | 4.00 |

Fritted glaze (cone 08)

| | | | | | |
|---|---|---|---|---|---|
| $K_2O$ | 0.10 | | | | |
| $Na_2O$ | 0.25 | | | | |
| CaO | 0.20 | $Al_2O_3$ | 0.15 | $SiO_2$ | 2.70 |
| MgO | 0.28 | $B_2O_3$ | 0.84 | $Sb_2O_3$ | 0.06 |
| BaO | 0.15 | | | | |

## III. Results and Conclusions

The glazes containing diatomite were superior to those containing flint in every property except color. They displayed a light straw coloration which would be objectionable if white glazes were desired. This would, however, be of little concern in colored glazes. Each glaze containing diatomite was more brilliant and had better gloss than the corresponding flint glaze and undoubtedly matured at a lower temperature. If a source of diatomite containing a lower iron content were available, it would be suitable for white glazes.

In fritting, the diatomite offered no difficulty and, in spite of its greater bulk volume, fused more rapidly. The two frits looked alike except in color. In quenching, the frit made with diatomite shattered to a smaller particle size.

Diatomite is an excellent source of silica for glazes and is readily available. It is easily mined, and, in most cases, no preparation except coarse grinding is necessary, as the desired fineness can be obtained in the glaze milling operation. A saving in operational cost is possible because the lower maturing temperatures require less fuel and allow a faster turnover of kilns.

Department of Ceramic Engineering
University of Washington
Seattle, Washington

* Presented at the Forty-Fourth Annual Meeting, The American Ceramic Society, Inc., Cincinnati, Ohio, April 22, 1942 (Materials and Equipment Division). Received April 20, 1942.

[1] Seeley W. Mudd Series: Industrial Minerals and Rocks, American Institute of Mining and Metallurgical Engineers, New York, 1937; p. 243.

[2] (*a*) Roy Erwin Swift, "Characteristics and Uses of Pacific Northwest Diatomites"; submitted in part for M.S. degree, University of Washington, College of Mines, 1940.

(*b*) Arthur Dammann, "Preliminary Study of the Properties and Uses of Pacific Northwest Diatomites"; submitted in part for M.S. degree, University of Washington, College of Mines, 1939.

# NEW JERSEY GLAUCONITE AS A MAJOR CONSTITUENT OF SOME BROWN GLAZES*

By Girard W. Phelps

Abstract

Three brown glazes containing a New Jersey glauconite as a major constituent calculated theoretically performed as expected and gave good results.

## I. Introduction

In a recent study of a New Jersey glauconite (greensand marl), the observation was made that this material might have possible merit as a brown glaze colorant if properly compounded in glaze formulas. The work which follows was an outgrowth of this idea.

## II. Glaze Calculation

The chemical analysis[1] of the glauconite (Hornerstown, New Jersey, marl) under consideration is as follows: $SiO_2$ 50.96, $Al_2O_3$ 5.23, $Fe_2O_3$ 20.72, CaO 1.34, MgO 3.75, $K_2O$ 7.05, $Na_2O$ 0.83, and ignition loss 9.21%.

This analysis was recalculated to a theoretical formula (molecular) weight of 481[2] referred to the RO constituents as unity and regarding the ignition figure as chemically combined water.

The following soda-lime glass cullet was used where frit was required: $SiO_2$ 74.5, CaO 5.2, MgO 3.8, and $Na_2O$ 16.5%.

This was reduced to a theoretical molecular weight of 225 for purposes of glaze calculation.

Three bright glaze empirical formulas were set up to mature at cones 01, 5, and 10, respectively. Using the theoretical molecular weight of greensand, the following glazes were then calculated[3]:

Table I

Empirical Glaze Formulas

| | RO | | $R_2O_3$ | | $RO_2$ | |
|---|---|---|---|---|---|---|
| Cone 01 | PbO | 0.600 | | | | |
| | CaO | 0.055 | $Al_2O_3$ | 0.100 | | |
| | MgO | 0.116 | $Fe_2O_3$ | 0.126 | $SiO_2$ | 1.490 |
| | $K_2O$ | 0.063 | | | | |
| | $Na_2O$ | 0.166 | | | | |
| Cone 5 | PbO | 0.300 | | | | |
| | CaO | 0.216 | $Al_2O_3$ | 0.224 | | |
| | MgO | 0.156 | $Fe_2O_3$ | 0.186 | $SiO_2$ | 2.404 |
| | $K_2O$ | 0.205 | | | | |
| | $Na_2O$ | 0.123 | | | | |
| Cone 10 | CaO | 0.410 | | | | |
| | MgO | 0.186 | $Al_2O_3$ | 0.350 | | |
| | $K_2O$ | 0.377 | $Fe_2O_3$ | 0.226 | $SiO_2$ | 3.320 |
| | $Na_2O$ | 0.027 | | | | |

The lead oxide was added as litharge, potash as feldspar, and lime as whiting.

Table II

Glaze Batches (in Grams)

| | Cone 01 | Cone 5 | Cone 10 |
|---|---|---|---|
| Litharge | 466.0 | 233.0 | |
| Greensand | 355.0 | 434.0 | 533.0 |
| Cullet | 156.0 | 78.0 | |
| Clay | 43.0 | 29.0 | 15.0 |
| Feldspar | | 162.0 | 324.0 |
| Flint | | 17.0 | 34.0 |
| Whiting | | 47.0 | 94.0 |

## III. Experimental Work

One thousand-gram glaze batches were weighed, placed in ball mills with 85% water, and ground four hours. The prepared glazes were lawned through a 100-mesh screen, aged 24 hours, and applied to unfired stoneware clay disks.

All specimens were fired to cones 01, 5, and 10 in a small muffle kiln in a slightly oxidizing atmosphere. Firing times were 5, 7, and 9 hours, respectively, with no soaking.

## IV. Results

The formula designated as an 01 glaze had an 02 to cone 5 range but was badly over-fired at cone 10. The brown was fairly strong but lacked covering power. From an artistic standpoint, however, the color was good.

The cone 5 formula was a chocolate-brown mat at cone 01 and a dark-brown bright glaze at cone 5. It was somewhat over-fired at cone 10.

The cone 10 formula gave a reddish engobe effect at cone 5 and a dark-brown gloss at cone 10.

## V. Conclusions

The glauconite has definite possibilities as glaze material for browns, and glazes calculated from its theoretical molecular weight perform as expected.

United Clay Mines Corporation
Trenton, New Jersey

* Received July 6, 1943.

[1] G. R. Mansfield, "Potash in the Greensands of New Jersey," *N. J. Dept. Conservation and Development Bull.*, No. 23, p. 124 (1923).

[2] A. I. Andrews, Ceramic Tests and Calculations. John Wiley & Sons, Inc., New York, 1928; pp. 60–61; *Ceram. Abs.*, 7 [6] 415 (1928).

[3] A. I. Andrews, *op. cit.*, pp. 68–90.

Second Ceramic War Conference
April 2, 3, 4, and 5, 1944
Hotel William Penn, Pittsburgh, Pa.

# ACTIVITIES OF THE SOCIETY

## MEMBERS IN SERVICE*

The following members of this Society are in fighting units of war service. There are several in service in Washington not included in this Service Roster. This list, which was begun in September, 1942, and added to each succeeding month, is probably not complete, and we would appreciate information on other members.

(228) CHARLES W. DOUGAN, Missouri School of Mines, Rolla, Mo.
(229) THOMAS GROVE, New York State College of Ceramics, Alfred, N. Y.
(230) EKKEHARD L. KREIDL, Arthur D. Little Co., Cambridge, Mass.
(231) NATHAN R. SEWELL, Georgia School of Technology, Atlanta, Ga.
(232) MILTON TUTTLE, New York State College of Ceramics, Alfred, N. Y.

* These are in addition to the lists published monthly, beginning with the September, 1942, *Bulletin*, with the exception of the June, 1943, issue.

## NEW MEMBERS IN OCTOBER

**Corporation**

BELLAIRE ENAMEL CO., Charles Kapner (voter), Bellaire, Ohio.
CO-OPERATIVE ENAMELING CO., H. C. Beasley (voter), 2335 East 67th St., Cleveland, Ohio.
FULPER POTTERY CO., J. M. Stangl (voter), Trenton, N. J.
NATIONAL PORCELAIN CO., Nicholas H. Snyder (voter), 400 Southard St., Trenton 2, N. J.
ROBINSON VENTILATING CO., Robert R. Robinson (voter), Zelienople, Pa.

**Personal**

BEASLEY, H. C., 3259 Kenmore Rd., Shaker Heights, Ohio; general manager, Co-Operative Enameling Co.
BOLIN, EDWIN P., 440 W. North Ave., Elmhurst, Ill.; ceramic engineer, Chicago Vitreous Enamel Product Co.
DEROISSART, JOHN B., 2401 Westbrook Dr., Toledo, Ohio; secretary, Hixon-Peterson Lumber Co.
FERDINAND, GEORGE, 750 N. Euclid Ave., Ontario, Calif.; ceramic engineer, Kaiser Co., Inc.
GOLDSCHMIDT, RODOLFO A., 3a Calle Oriente 3, San Salvador, El Salvador, Central America; director and owner, Loceria Saturno.
HARTMAN, FRANCIS H., 226 Polson Ave., Winnipeg, Manitoba, Canada; chemist, Glass Containers Ltd.
HUTCHISON, CLYDE B., Box 225, Sandersville, Ga.; Champion Paper & Fibre Co.
KOLB, WILLIAM B., Kolb Refractories Co., Meadow and Jackson Sts., Philadelphia, Pa.; partner.
MACALPINE, WILLIAM M., 357 E. Main St., Somerville, N. J.; Johns-Manville Research Laboratory.
MARSH, FRANK L., Research Div., National Gypsum Co., Clarence Center, N. Y.; assistant director of research.
PEEL, FRED P., 11777 Minden, Detroit, Mich.; engineer, Clayton & Lambert Mfg. Co.
PLUESS, OTTO, 1336 First National Bldg., Box 1314, Oklahoma City 1, Okla.; manager and engineer, Brick and Tile Association of Oklahoma.
VALENTINE, PETER C., 620 Market St., San Francisco 4, Calif.; manager, Sand Dept., Del Monte Properties Co.
VANDOLAH, HARRY J., 1015 Division St., Oak Park, Ill.; research chemist, Chicago Vitreous Enamel Product Co.
WISE, LEONARD G., E. I. du Pont de Nemours & Co., Inc., Experimental Sta., Wilmington, Del.

**Student**

*University of Illinois:* LOUIS R. MCCREIGHT.
*Ohio State University:* JOHN B. CAHOON, JR., WILLIAM D. CALDWELL, TED H. HARLEY, GRANT E. MILLER, HAL H. RICE, AND PAUL G. THOMPSON.
*University of Saskatchewan:* JOHN R. KILCOYNE.

## MEMBERSHIP WORKERS' RECORD

CORPORATION: A. I. Andrews 1, J. F. Hunt 1, R. Russell, Jr. 1, Office 2.
PERSONAL: A. S. Adcock 1, W. O. Brandt 1, H. T. Coss 1, R. L. Fellows 2, P. G. Herold 1, J. F. Hunt 1, R. J. Montgomery 1, E. C. Petrie 1, G. B. Remmey 1, M. C. Stratton 1, Office 4.
STUDENT: R. L. Cook 1, A. S. Watts 6, W. G. Worcester 1.
GRAND TOTAL: 28.

## ROSTER CHANGES FOR OCTOBER*

EUBANK, WILLIAM R., Mellon Institute, Pittsburgh, Pa. (Ambler, Pa.)
FISK, HENRY G., University of Wyoming, Laramie, Wyoming (Chicago, Ill.)
MURPHY, REMINGTON M., 1913 W. Genesee St., Syracuse, N. Y. (Keyport, N. J.)

* Address in parentheses is former address.

**I Will Be Selfish Enough to Put My Head Together With Others**
**My Membership in The American Ceramic Society Is for a Selfish Purpose**

## SOUTHERN CALIFORNIA SECTION

The annual social meeting of the Southern California Section was held September 25 at the Elk's Club in Los Angeles, Calif. Our attendance was about sixty-five, and a very good time was had by all. We were pleased to have as a guest from the Northern California Section, Waldemar F. Dietrich of Sacramento Junior College, Sacramento, Calif.

—W. O. BRANDT, *Secretary*

## Research Achieves Progress

By Research Scientific Facts Are Disclosed

And Applied to Service of Mankind

Two Thousand Two Hundred and Sixty-Four

Free Enterprise Industrial Concerns

In 1940 Maintained Research Laboratories

Without Extravagant Duplication of Effort and With

Results Obtained Being Made Known

*There Is No Good Reason for*

*Governmental Bureaucracy Control*

PAID MEMBERSHIP AND SUBSCRIPTION RECORD

| Date of Record | Members Paid | | Deferred | Subscriptions | Monthly Sales | Total Circulation |
|---|---|---|---|---|---|---|
| | Personal | Corporation | | | | |
| February 21, 1943 | 2095 | 267 | 10 | 451 | 220 | 3043 |
| September 21, 1943 | 2021 | 295 | 6 | 487 | 220 | 3029 |
| October 21, 1943 | 2043 | 302 | 6 | 501 | 220 | 3072 |
| A Year Ago | 2031 | 268 | 21 | 450 | 220 | 2990 |
| Gain | 12 | 34 | 15 | 51 | | 82 |

**Kill That Kilgore Bill**

**So Members of This Society May Not**

**In Free Enterprise Be Collaborating in Vain**

## PITTSBURGH SECTION

The first meeting of the year for the Pittsburgh Section was held October 12 at Mellon Institute, Pittsburgh, Pa.

The principal speaker of the evening was Louis A. Smith, Refractory Engineer, Jones & Laughlin Steel Corp., who discussed "Steel Plant Refractory Problems." The subject, which is a highly important one from the standpoint of steel production for the war effort, involved methods of increasing the useful life of open-hearth and blast-furnace linings as well as boiler furnaces and coke-oven linings. The use of insulation and special shapes and the application of superquality or superduty refractories was also stressed. This talk immediately stimulated considerable discussion on the subject and H. M. Kraner, L. D. Hower, R. E. Birch, T. M. Fairchild, E. E. Marbaker, and others contributed to an interesting meeting.

The nominating committee consisting of Ralston Russell, Jr., *Chairman*, H. C. Harrison, and J. W. Jordan announced the following candidates for office for the coming year:

*Chairman:* WALTER C. RUECKEL, Koppers Co., Pittsburgh, Pa.
*Vice-Chairman:* H. E. SIMPSON, Mellon Institute, Pittsburgh, Pa.
*Secretary:* J. W. JORDAN, Mellon Institute, Pittsburgh, Pa.
*Treasurer:* LOUIS A. SMITH, Jones & Laughlin Steel Corp., Aliquippa, Pa.

—H. E. SIMPSON, *Secretary*

# CERAMIC EDUCATIONAL COUNCIL

## MINUTES OF ANNUAL MEETING

The annual meeting of the Ceramic Educational Council was held April 18, 1943, in Pittsburgh, Pa. The luncheon meeting was called for 12:15 P.M.

President Nelson W. Taylor presided at the meeting. The minutes of the 1942 meeting as they appeared on page 170 of the August, 1942, *Bulletin of The American Ceramic Society* were approved as printed.

The report of the Nominating Committee sent in by P. G. Herold presented R. M. Campbell for President, C. M. Dodd for Vice-President, E. C. Henry for Secretary, R. M. King for Nominating Committee A, and E. P. McNamara for Nominating Committee B. A motion that the nominations be closed was made by J. W. Whittemore and seconded by M. E. Holmes. The motion was put to a vote and carried.

Chairman C. M. Dodd reported for the Committee on Distribution of Ceramic Courses in Ceramic Engineering. During discussion of the report suggestions were made as follows:

(1) That next year the Committee solicit recommendations on desirable changes in the ceramic curricula in order to meet new conditions and recommend important and fundamental changes in our ceramic curricula. The motion was put to a vote and carried.

(2) That an average curriculum based on the curricula of all ceramic engineering departments be included in the next report of the Committee.

Chairman S. R. Scholes presented the report for the Committee on the History of Ceramic Education (Joint Committee for Fellows and Ceramic Educational Council). Discussion showed that the ceramic phase of mineral industry education has been written by T. T. Read of Columbia University, which should suffice in these busy times.

Chairman M. J. Rice of the Committee on Instruction in Semi-Microqualitative Analyses was not present and no report was sent.

Chairman A. E. Badger of the Committee on Physical Chemistry was ill so no report was presented.

Chairman E. P. McNamara of the Committee on Extension Instruction had no report to make in addition to that given last year. Dr. Andrews suggested that a new committee be formed to lay plans for ceramic education for the immediate postwar period.

Chairman A. I. Andrews reported for the Committee on the Draft Status of Ceramic Students. Dean M. E. Holmes moved (seconded by J. W. Whittemore) that the Council recommend to the Board of Trustees that they proceed with the plan of presenting the resolution given on pages 7 and 8 of the "Annual Report of the Chairman of the Special Committee on the Status of Ceramic Engineers with the Selective Service Board" to the War Manpower Commission as recommended by The American Ceramic Society Committee on Deferment of Students (see pp. 180–81, June, 1943, *Bulletin*).

President N. W. Taylor presented the question of a publicity campaign as recommended by the Ceramic Educational Council. The motion was carried.

President N. W. Taylor presented a recommendation that the Council prepare a comprehensive definition for ceramic engineering-technology. A. S. Watts moved that a committee be appointed to prepare a comprehensive definition of the field of ceramics and related problems concerning ceramic education and ceramic technology. The motion was carried.

President Taylor next presented the problem of the utilization of the immediate supply of ceramic engineers-technologists as well as insuring a supply for future needs. C. R. Amberg moved (seconded by E. P. McNamara) that this problem and the use of ceramic engineers for war needs be referred to the committee. The motion was carried.

C. M. Dodd moved (seconded by M. E. Holmes and E. C. Henry) the adoption of the recommendation to the Board of Trustees of the publicity campaign recommended by the Ceramic Educational Council (see pp. 185–86, June, 1943, *Bulletin*).

A. F. Greaves-Walker moved the changing of the word "chemical" in the recommendation to "chemical engineering" as a more popular term. The motion was carried.

President Taylor introduced the new officers:

*President:* R. M. CAMPBELL, New York State College of Ceramics, Alfred, N. Y.
*Vice-President:* C. M. DODD, Iowa State College, Ames, Iowa.
*Secretary:* E. C. HENRY, Pennsylvania State College, State College, Pa.

J. L. Carruthers, Chairman of the Committee on Content of Ceramic Courses, presented copies to members of a report made last year.

The meeting adjourned at 2:50 P.M.

—C. M. DODD, *Secretary*

# SALUTE TO SOME OF OUR MEMBERS

## MILTON FERDINAND BEECHER

**Chairman, Committee on Classification and Nomenclature, The American Ceramic Society**

Milton Ferdinand Beecher, a member of The American Ceramic Society for thirty-three years, was born April 21, 1887, in Mason City, Iowa. He attended the Mason City grade and high schools and was graduated in 1910 from the Iowa State College, Ames, Iowa, with a B.S. degree in Ceramics. In 1915, he also received the professional degree of ceramic engineer from the same school.

Immediately following his graduation from college in 1910, Mr. Beecher became yard foreman for the Boone Brick Tile & Paving Co., Boone, Iowa. In 1911, he was employed as assistant to the superintendent of the Western Stoneware Co., Monmouth, Ill., and from 1911 to 1915, he

was associated with the Iowa Engineering Experiment Station, Ames, Iowa, as assistant engineer.

At the present time he is Director of Research for the Norton Co., Worcester, Mass., where he has amplified the research and development activities of the Company and has improved coordination with manufacturing groups.

**Milton Ferdinand Beecher**

A charter member of the Fellows of The American Ceramic Society, Mr. Beecher has served The Society as a member of the Committee on Standards (1917–1923) and of the Committee on Publications (1933–1936). He also has served on the Board of Trustees (1919–1921). At the present time, he is affiliated with the Refractories Division.

Mr. Beecher is also a member of the Founder's Group of the Institute of Ceramic Engineers, Tau Beta Pi, and Phi Kappa Phi.

**Publications**

(1) "Investigation of Iowa Fire Clays," *Iowa State Coll. Agric. Mech. Arts, Eng. Expt. Sta. Bull.*, No. 40, 1915.

(2) (With H. F. Staley) "Practical Handling of Iowa Clays," *ibid.*, No. 43.

(3) "Tests of Iowa Fire Clays," *Trans. Amer. Ceram. Soc.*, **17**, 102–24 (1915).

(4) "Methods for Saturating Clay Trials for Absorption and Porosity Determinations," *ibid.*, **18**, 73–79 (1916).

(5) "Lightweight Clay Refractories," *Jour. Amer. Ceram. Soc.*, **2** [5] 336–55 (1919).

(6) "Developments in the Manufacture of Refractories of Fused Alumina," *ibid.*, **6** [1] 292–94 (1923).

(7) "Requirements of Sagger Bodies," *Bull. Amer. Ceram. Soc.*, **2** [8] 251–53 (1923).

(8) "Properties of Some Special Refractories," *Forging, Stamping, Heat Treating*, **13**, 456 (1927).

(9) "Important Properties and Requirements of Some Special Refractories," *Trans. Amer. Soc. Steel Treating*, **13**, 473–84 (1928).

**Patents**

(1) (With R. C. Purdy) "Lightweight Refractory Brick," U. S. 1,345,632, July 6, 1920.

(2) "Translucid Antislipping Tile," U. S. 1,374,136, April 5, 1921.

(3) "Antislipping Vitrified Tile," U. S. 1,377,957, May 10, 1921.

(4) (With R. C. Purdy and A. A. Klein) "Refractory Article of Magnesia and Alumina," U. S. 1,394,442, Oct. 18, 1921.

(5) "Safety-Tread Tile," U. S. 1,439,285, Dec. 19, 1922.

(6) "Bonded Alumina Refractory Material," U. S. 1,439,286, Dec. 19, 1922.

(7) (With M. C. Booze) "Bonded Carbide Grains with Ceramic Material," U. S. 1,444,162, Feb. 6, 1923.

(8) (With G. N. Jeppson) "Safety-Tread Ceramic Tile," U. S. 1,445,083, Feb. 13, 1923.

(9) (With M. C. Booze) "Laminated Superrefractory Article," U. S. 1,448,684, March 20, 1923.

(10) (With R. C. Purdy and A. A. Klein) "Bonded Articles of Magnesia and Alumina," Can. 229,902, March 27, 1923.

(11) (With A. A. Klein) "Nonslip Tile," U. S. 1,451,462, April 10, 1923.

(12) (With H. W. H. Beth) "Tunnel Kiln," U. S. 1,485,109, Feb. 26, 1924.

(13) (With A. A. Klein and W. W. Greenwood) "Vitreous Bonded Silicon Carbide Abrasive Article," U. S. 1,546,115, July 14, 1925.

(14) (With C. B. Tilton) "Article of Silicate Bonded Granules," U. S. 1,555,086, Sept. 29, 1925.

(15) (With M. C. Booze) "Making Articles of Ceramic-Bonded Granular Material," U. S. 1,567,020, Dec. 22, 1925.

(16) (With A. E. Olson) "Tunnel-Kiln Car," U. S. 1,587,210, June 1, 1926.

(17) (With G. N. Jeppson) "Making Laminated Ceramic Articles," U. S. 1,614,926, Jan. 18, 1927.

(18) (With L. E. Saunders and L. H. Milligan) "Abrasive Product and Method of Making," U. S. 1,829,761, Nov. 3, 1931.

(19) (With C. H. Quick) "Making Articles of Ceramic-Bonded Granular Material," U. S. 2,140,650, Dec. 20, 1938.

## VICTOR WILLIAM BOEKER

**Chairman, Papers and Program Committee, Structural Clay Products Division**

Victor William Boeker was born in Edwardsville, Ill., September 23, 1902. He received his elementary education at the Lutheran Parochial School and was graduated from the Edwardsville High School in 1920. In 1924, he received the B.S. degree in ceramic engineering from the University of Illinois, Urbana, Ill., with final honors in the College of Engineering and special honors in ceramic engineering.

After spending one year doing research work in metal enamels for the American Stove Co., St. Louis, Mo., Mr. Boeker became associated with the Richards Brick Co., Edwardsville, Ill., where since 1925 he has been engaged successively in general and sales engineering work (1925–1928), in the design and construction of a complete structural clay products plant (1929–1930), as director of the Company in charge of production (1931), and as vice-president in charge of production and development (1932). Since 1932, he has been devoting his efforts toward production management, sales promotion, advertising and publicity, and public relations and trade association work.

A member of The American Ceramic Society since

1923, Mr. Boeker is also a member of the Founders' Group of the Institute of Ceramic Engineers; the Illinois Clay Manufacturers Association (chairman in 1937 of the Executive Committee charged with reorganizing the Association; vice-president, 1938; president, 1939; and member of the Executive Committee, 1940–1942); the Edwardsville Chamber of Commerce (director for three terms, vice-president for one term, and president for one term); the St. Louis Engineers' Club (member of the Meetings and Technical Program Committee, 1941–1943); the Illinois Ceramic Institute; Alpha Chi Sigma; Keramos; Tau Beta Pi; and Sigma Xi (associate member). He is also active in industrial and trade association, civic, church, and Boy Scout work.

Victor William Boeker

**Publications**

(1) "Investigation on Enamel Clays," *Jour. Amer. Ceram. Soc.*, **9** [7] 399–411 (1926).
(2) "Controlling Gases in a Haigh Continuous Kiln," *Brick & Clay Record*, **75** [6] 361–62 (1929).
(3) "Display of Face Brick," *Clay-Worker*, **92** [2] 109–12 (1929).
(4) "Construction and Operation of a Special Diamond Core Drill for Exploring Shale Deposits," *Bull. Amer. Ceram. Soc.*, **9** [5] 145–49 (1930).
(5) "Exploring Clay Deposits by Drilling," *Brick & Clay Record*, **76** [11] 700–703 (1930).
(6) "Methods of Firing Control," *ibid.*, **89** [1] 18–20 (1936).

## MORRISS CORBMAN

**Member, Committee on Classification and Nomenclature, Structural Clay Products Division**

Morriss Corbman, a June, 1936, graduate of the New York State College of Ceramics, Alfred, N. Y. (B.S. in Ceramic Technology), was born September 21, 1913, in New York, N. Y. Immediately following graduation, he became associated with the Binghamton Brick Co.,

Morriss Corbman

Binghamton, N. Y. While with this Company, he was offered a Fellowship by the Brick Manufacturers of New York State at the New York State College of Ceramics. He worked on this Fellowship for six months under the direction of H. G. Schurecht, and his experimental results were published in Bulletin No. 1 of the New York State College Ceramic Experiment Station under the title "Use of New York State Clays in Masonry Mortars."

In July, 1937, Mr. Corbman returned to the Binghamton Brick Company and in 1939 was appointed head ceramic engineer in charge of all ceramic research and production of red glazed brick and tile.

In December, 1941, he accepted a position as superintendent of the Cunningham Brick Co., Thomasville, N. C., where he was in charge of all production and development of brick and tile.

Since May, 1943, he has been associated with the Bethlehem Steel Co., Bethlehem, Pa., as field engineer in the Combustion Engineering Department. In this capacity, he deals with all the phases of ceramic and refractory problems which arise in the steel company.

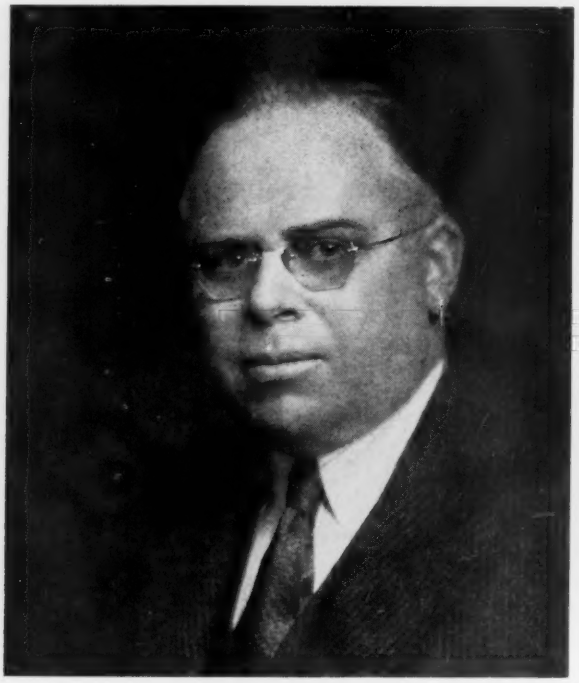
Mr. Corbman has been a member of The American Ceramic Society since January, 1943.

***The Second War Congress Will Be a Free Enterprise Exchange***
***Unhampered by Bureaucratic Control***
***If You Contribute Results of Your Investigations***

## WILLIAM CARR McGOLPIN

**Member, Nominating Committee, Structural Clay Products Division**

William Carr McGolpin was born in Toronto, Ontario, Canada, July 4, 1887, and is the descendant of early Irish and English pioneers. His great-grandfather was an early carpenter contractor in Toronto, and several of the buildings erected by him are still occupied. Mr. McGolpin attended the Dufferin School, Toronto, and after leaving school was employed for many years by the National Cash Register Co., Toronto. Later he entered the construction field with the Mason contracting company of H. N. Dancy & Son, went overseas in the first World War with the Divisional Signallers, and in 1920 became associated with the National Fire Proofing Company of Canada, Ltd. He became general manager of the Company in 1931 and president in 1941.



**William Carr McGolpin**

Mr. McGolpin has taken an active part in the Canadian Ceramic Society as a member of all its various committees. At present, he is chairman of the Clay Division. He has been a member of The American Ceramic Society since 1929 and acted as local chairman for The Society during its Toronto Meeting in 1940.

He is president of the recently formed Brick and Tile Manufacturers Association of Canada, which includes all the manufacturers from coast to coast, and is their representative on the National Construction Council and the Heavy Industries Federation and a member of the Ceramic Advisory Committee. He is also a member of the Canadian Engineering Standards Association and the Engineers' Club.

## DONALD HAGAR

**Chairman, Nominating Committee, White Wares Division**

Born in Tivoli, N. Y., December 13, 1897, the son of John H. and Barbara A. Hagar, Donald Hagar attended grammar school in Tivoli and high school in Red Hook, N. Y. In 1914, he entered the New York State College of Ceramics, Alfred, N. Y., where he remained until April, 1917, at which time he left to join the United States Navy. After being discharged in January, 1919, he continued his studies at the same school and in June, 1919, received his B.S. degree in Ceramic Engineering. In 1937, he also received the professional ceramic engineering degree from the same school.

From 1919 to 1921, Mr. Hagar was employed as ceramic engineer by the Jeffery-Dewitt Co., Detroit, Mich. Thereafter he worked successively as superintendent of Plant No. 2, Mosaic Tile Co., Matawan, N. J. (1921–1927) and as works manager in charge of research and production for the Cambridge Tile Mfg. Co., Cincinnati, Ohio (1927–1931). Since 1931, he has been consulting engineer and sales representative for various producers of ceramic materials, with headquarters in Zanesville, Ohio. Among other achievements, Mr. Hagar has developed and promoted the general use of talc in various whiteware bodies, particularly in wall tile.

**Donald Hagar**

Mr. Hagar, a Fellow of The American Ceramic Society and a member since 1919, has been active in the White Wares Division, having served as chairman of the Committee on Management (1935–1936) and as a member of the Committee on Research (1935–1937), Nominating Committee (1937–1938), and Committee on Membership (1938–1939). He has also served as chairman of the Society Committee on Membership (1940–1941).

Mr. Hagar is a charter member of the Institute of Ceramic Engineers and a member of the Ohio Ceramic Industries Association, the New Jersey Ceramic Association, the Ceramic Association of New York, the Zanesville Rotary Club, the Zanesville University Club, and the Zanesville Golf Club.

**Publications**

(1) "Controlling a Control System," *Ceram. Ind.*, **17** [1] 30–38 (1931).
(2) "Lengthening Sagger Life with Talc," *Ceram. Age*, **21** [2] 35–37, 63 (1933).
(3) "Talc May Stop That Crazing," *ibid.*, [3] 74–75.
(4) "Effect of a Tremolitic Talc in Whiteware Bodies," *Jour. Amer. Ceram Soc.*, **19** [1] 14–23 (1936).

**Patents**

"Talc-Containing Ceramic Composition," U. S. Pat. 2,213,495, Sept. 3, 1940, and Brit. Pat. 541,695, Dec. 17, 1941.

## CHARLES L. CRUIKSHANK

**Chairman, Committee on Industrial Management, Materials and Equipment Division**

Charles L. Cruikshank was born January 31, 1898, in Inverness Province, Quebec, Canada. He lived successively in San Marcial, N. Mex., Salem, Ohio, and Detroit, Mich., and was graduated from Salem High School in 1916 and enrolled at Dartmouth College as a freshman engineer. He joined the Navy April 14, 1917, as Seaman First Class and was relieved from active duty February 21, 1919, as an Ensign. He then enrolled at the University of Michigan and received his B.A. degree in 1921, having specialized in Business Administration.

Charles L. Cruikshank

After spending a few years as an accountant, Mr. Cruikshank took a position in the By-Products Sales Department of the Semet Solvay Co., Detroit. Then, as salesman for the Warner R. Thompson Co., Detroit, he became interested in nonmetallic minerals. This led to an active part in developing the interest of the glass and whiteware industry in the use of nepheline syenite. H. R. Deeth, of Toronto, saw the possibilities of this new ceramic material and formed the Canadian Nepheline Company in 1935 to acquire nepheline deposits and erect a processing plant. Mr. Deeth appointed Mr. Cruikshank as exclusive United States sales agent, and Mr. Cruikshank, in turn, created and is managing the Ceramic Division of the Great Lakes Foundry Sand Co., Detroit, Mich. This Division has been active since then in the development and research program required in the introduction of a new ceramic raw material.

Mr. Cruikshank has been a member of The American Ceramic Society since 1936.

## OTIS LOVEJOY JONES

**Chairman, Committee on Industrial Management, Refractories Division**

Otis Lovejoy Jones was born in Crete, Neb., May 8, 1879. He attended the high schools in Lincoln, Neb., and Hyde Park, Chicago, Ill., and the Lewis Institute of Technology in Chicago.

From 1900 to 1906, he was with the Harbison-Walker Refractories Co., Pittsburgh, Pa., where he was employed in their engineering, plant operation, and sales departments.

In 1906, he became superintendent of the American Refractories Company and designed, built, and operated their silica brick plant at Rockdale near Joliet, Ill. This was the first plant to produce silica brick from Wisconsin ganister and the first to manufacture Koppers coke-oven brick in silica material.

In 1911, he organized and was first president of the Illinois Clay Products Company, which built a plant for developing the fire-clay deposit at Deer Park, near Oglesby, in La Salle County, Ill.

In 1923, this plant was removed to exploit a newly discovered fire-clay deposit at Goose Lake near Joliet, Ill. A large and modern fire-clay grinding plant was built; later a firebrick plant using periodic kilns at the outset followed by two circular continuous tunnel kilns, the first ever used for firing heavy clay products. This plant has pioneered in several brick-manufacturing developments, including deairing of pressed brick, automatic kiln coal feeders, improved-design power presses, and the utilization of illite and halloysite as clay minerals and of vermiculite for high-temperature insulation products.

Mr. Jones is a director of the American Refractories Institute and a member of The American Ceramic Society, the American Society for Testing Materials and its Committee C–8, and of the American Institute of Mining and Metallurgical Engineers. He is active in many civic enterprises and is a member of several national trade associat.ons and their committees.

**Patents Issued to O. L. Jones**

(1) "Plastic Refractory Insulating Material," U. S. 2,043,249, June 9, 1936.

(2) "Porous Refractory Insulating Cement," U. S. 2,063,102, Dec. 8, 1936.

(3) "Refractory Insulation," U. S. 2,081,935, June 1, 1937.

(4) "High-Temperature Insulating Composition," U. S. 2,103,463, Dec. 28, 1937.

(5) "Refractory Insulation," Can. 374,451, June 14, 1938.

(6) "Refractory Cement," U. S. 2,240,159, April 29, 1941.

## CLAUDE MILTON LAMBE, JR.

**Chairman, Papers and Program Committee, White Wares Division**

Claude Milton Lambe, Jr., son of C. M. Lambe, professor of civil engineering at the North Carolina State College, was born December 10, 1918, in Raleigh, N. C. He attended the Wiley School in Raleigh, was graduated in 1935 from the Needham Bourghton High School, and in June, 1939, was graduated from the North Carolina State College with a B.S. degree in Ceramic Engineering.

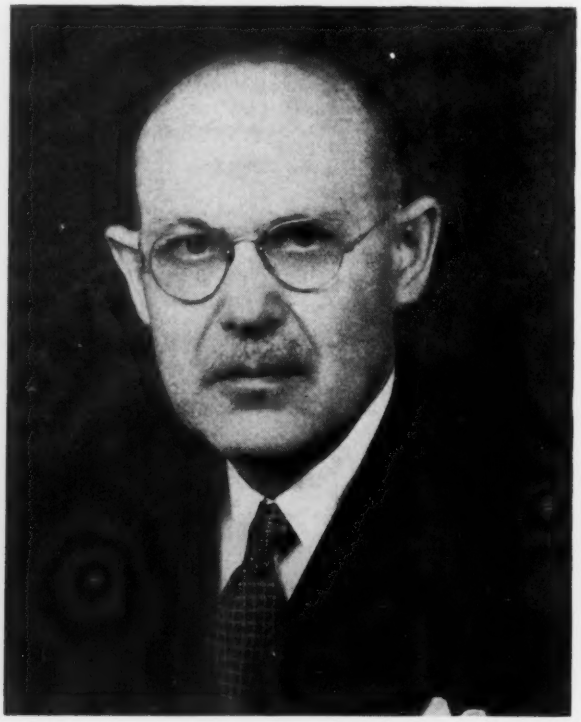
From June until January, 1940, Mr. Lambe worked for the Federal Housing Authority as a soils engineer on foundations, and for the following two and one-half years he was employed by the Eljer Co., Ford City, Pa., as foreman and control and production engineer in slips and glazes.

At present he is on leave of absence from his duties as instructor in ceramic engineering at the North Carolina State College to carry out research on steatite for the War Production Board and to work on his Master's degree, which he will receive in March, 1944.

Mr. Lambe, a registered engineer in the State of North Carolina, is a member of The American Ceramic Society, the Institute of Ceramic Engineers (associate member), and Keramos.

He is the author of two papers which have been published in *The Bulletin of The American Ceramic Society*, viz., (1) "Control of Clays Containing Varying Quantities of Adsorbed Salts," **20** [5] 155–58 (1941) and (2) "Casting-Rate Tests (Symposium on Testing and Classification of Ball Clays)," **21** [11] 274–76 (1942).

Claude Milton Lambe, Jr.



Theodore Lenchner

## THEODORE LENCHNER

**Vice-Chairman, Design Division**
**Chairman, Committee on Membership, Design Division**

Theodore Lenchner was born November 14, 1888, in New York, N. Y., the son of the late Sigmond and Esther Lenchner. He attended grade and high school in Pittsburgh, Pa. In 1908, he entered the Pennsylvania State College, State College, Pa., where he enrolled in the School of Chemistry and received the Bachelor of Science degree upon graduation in 1912.

After graduation, he became associated successively with the American Vanadium Co., Bridgeville, Pa. (1912–1914) as analytical chemist; the O. Hommel Co., Pittsburgh, Pa. (1914–1920) as research director and superintendent; the Vitro Mfg. Co., Pittsburgh, Pa. (1921–1926) as director of the Glass and Pottery Color Department; and the Roessler & Hasslacher Chemical Co. (now the E. I. du Pont de Nemours Co.), New York, N. Y. (1927–1931) as color specialist. In 1932, he again became associated with the Vitro Mfg. Company as sales and service representative, which position he holds at the present time.

During his professional career, Mr. Lenchner has been particularly interested in color and its application to ceramic art. He was among the first to reproduce ceramic colors heretofore purchased abroad and has been responsible for a number of new colors for both glass and pottery use. He has also made possible the manufacture of these colors on a commercial scale and at prices well below those of imported colors. He has done considerable work in applied art as practiced commercially in the ceramic industry and has given demonstrations and lectures on this phase. He has also set up five or six of the larger decorating shops which exist today.

Mr. Lenchner has been a member of The American Ceramic Society since 1923 and a Fellow since 1938. He has been quite active in the Art Division, having served as second vice-chairman of the Division (1939–1940) and as chairman of the Committee on Data (1937–1938), Committee on Industrial Management (1939–1940), and Committee on Rules (1940–1943).

**Publications**

(1) "Glass Decorators' Palette and Its Preparation," *Jour. Amer. Ceram. Soc.*, **6** [10] 1040–43 (1923).

(2) "Use of Uranium Compounds," *Glass Ind.*, **7** [8] 185 (1926).

(3) "Liven Up Sales with Colored Glass Containers," *Ceram. Ind.*, **9** [5] 555 (1927).

(4) "Color and Its Application to Ceramic Art," *Jour. Amer. Ceram. Soc.*, **10** [7] 538–42 (1927).

(5) "Glass Lighting Unit Again in Vogue," *Glass Ind.*, **9** [8] 180 (1928).

(6) "Future of the Small Plant," *Ceram. Age*, **12** [3] 89 (1928).

(7) "Preparation and Standardization," *Amer. Enameler*, **2** [2] 10 (1929).

(8) "New Colored Glass," *Glass Ind.*, **10** [2] 49 (1929).

(9) "Incrustation of Ceramic Ware," *Jour. Amer. Ceram. Soc.*, **12** [7] 498–501 (1929); reprinted in *Pottery Gaz.*, **54** [626] 1275–76 (1929) and *Nat. Glass Budget*, **45** [19] 23 (1929).

(10) "Need of Ceramic Research in Industrial Applied Art," *Ceram. Ind.*, **16** [6] 547–48 (1931).

(11) "Possibilities for Glass Containers Decorated with Vitrifiable Colors," *ibid.*, **18** [6] 362–64 (1932).

(12) "Colors and Design on Glass Package Foods," *Canning Age*, July, 1932.

## JACK FRANKLIN DAY

**Secretary, Materials and Equipment Division**

Jack Franklin Day was born August 29, 1916, in Columbus, Ohio. He attended the Columbus schools and was graduated from East High School in 1934. He received his B.S. degree in Ceramic Engineering from Ohio State University in June, 1938, and his M.S. degree in June, 1939.

He started to work for the Cronin China Co., Minerva, Ohio, as plant engineer in June, 1938, and continued working while obtaining his M.S. degree. He had previously worked one summer in the laboratory of the A C Spark Plug Co., Flint, Mich., to obtain the necessary practical experience for graduation.

**Jack Franklin Day**

Mr. Day left the Cronin China Company in September, 1940, to work for Donald Hagar in Zanesville, Ohio. His job at present is one of sales development and research on ceramic materials, chiefly talc, as Mr. Hagar is consulting engineer for the W. H. Loomis Talc Corp., Gouverneur, N. Y.

Mr. Day has been a member of The American Ceramic Society since 1936 and is a member of the Institute of Ceramic Engineers, Keramos, and Sigma Gamma Epsilon.

WE MUST CARRY ON
The Annual Meeting the First Week of April
Is Important for Each of Us
WE MUST NOT FALTER

(1943)

## GRANT DIAMOND HEADS ELECTRO REFRACTORIES

Grant Sidney Diamond has been elected president of the Electro Refractories & Alloys Corp., Buffalo, N. Y., to succeed Luke U. Milward, who died June 9, 1943.

Mr. Diamond, executive vice-president of the Company since 1941, was born December 25, 1901, in Buffalo, N. Y., attended the Buffalo elementary schools, and was graduated from the Hutchinson High School in Buffalo in 1919.

**Grant Sidney Diamond**

In June, 1923, he was graduated from the University of Buffalo with the degree of analytical chemist, at which time he received the Naomi Gold Medal for the highest scholastic standing for the three-year course in chemistry. Joining the Electro Refractories & Alloys Corporation as assistant research chemist immediately after graduation, Mr. Diamond advanced successively to research chemist (1924), director of research (1925–1928), plant manager (1928–1933), and vice-president (1933). In 1941, he was made executive vice-president and elected to the Board of Directors.

Mr. Diamond's extensive work on refractories includes the development of (1) special kiln furniture, crucibles, etc., which utilize silicon carbide, (2) refractory cements which utilize silicon carbide, fused aluminum oxide, fused magnesium oxide, and fused silica, and (3) special furnaces and furnace constructions.

In June, 1940, he received the professional degree of ceramic engineer from the New York State College of Ceramics, Alfred, N. Y.

Mr. Diamond has been a member of The American Ceramic Society since 1926 and was elected to the Fellowship in 1940. He has served as chairman of the Membership Committee (1935–1939) and as a member of the Refractories Division Program Committee (1939–1941).

In 1935, he was chairman of the Meetings and Service Committee for the Annual Meeting of The Society held in Buffalo.

He is also a member of the Institute of Ceramic Engineers, the Ceramic Association of New York (Director, 1940, and President since 1941), and an Honorary Member of the New York State chapter of Keramos.

**Publications of Mr. Diamond**

"Tercod, a New Refractory Brick for Electric Furnaces," *Trans. Electrochem. Soc.* (Preprint), **63,** 4 pp. (1933).

"Properties and Performance of Silicon Carbide Batts in the Porcelain and Other Ceramic Industries," *Bull. Amer. Ceram. Soc.*, **15** [9] 297–98 (1936).

"Factors Affecting Life of Kiln Furniture in the Whiteware Industry," *ibid.*, **19** [10] 371–78 (1940).

**Patents**

"Refractory Article and Material," U. S. 1,674,961, June 26, 1928.

"Glazing Refractory Article," U. S. 1,828,767, Oct. 27, 1931.

"Kiln Furniture," U. S. 2,118,641, May 24, 1938.

### Other Organization Changes

Other changes have been made in the Electro organization following the death of Mr. Milward.

Two new vice-presidencies have been established, which posts are held by Carl F. Leitten, vice-president in charge of manufacturing, and Philip Donham, vice-president in charge of finance. These are in addition to C. A. Asher, vice-president, who continues in the same capacity. William Enslin, formerly assistant treasurer, has been made secretary, and E. Halsey Brister, formerly abrasive engineer, has been promoted to assistant plant manager.

**Carl F. Leitten**

Eugene P. Harter has been made general sales manager and has taken over the sales administrative duties of Mr. Diamond.

**Eugene P. Harter**

Mr. Leitten, who studied at the University of Buffalo, became associated with Electro Refractories in 1926 as laboratory assistant and served as superintendent of the Refractories Division of the Company from 1936 to 1942, when he was made superintendent in charge of production. In January, 1943, he was appointed plant manager.

Mr. Donham, formerly secretary-treasurer, has been with the Company since 1941. A graduate of Harvard University and the Harvard Graduate School of Business, he was formerly engaged in commercial banking.

A biographical sketch of Mr. Harter appeared on p. 321 of the September, 1943, issue of *The Bulletin*.

## CHANGES AT CHAMPION SPARK PLUG COMPANY

Joseph A. Jeffery, vice-president and general manager of the Ceramic Division of the Champion Spark Plug Co., Detroit, Mich., has announced the appointment of Frank H. Riddle as factory manager and Herbert F. Royal as director of research succeeding Mr. Riddle.

OUR FORTY-SIXTH ANNUAL MEETING,
April 2, 3, 4, and 5, 1944
Hotel William Penn, Pittsburgh, Pa.
Is Your Opportunity to Advance Ceramics

## EUGENE E. BRYANT ADVANCED AT FERRO

Eugene E. Bryant, a member of The American Ceramic Society since 1941, has been appointed Director of Ceramic Research for the Ferro Enamel Corp., Cleveland, Ohio. He will work under G. H. McIntyre, Director of Research.

**Eugene E. Bryant**

Mr. Bryant was born December 27, 1907, in Dryden, N. Y. In 1926 he was graduated from high school in Macedon, N. Y., and in 1931 he received his Bachelor of Science degree in Ceramic Engineering from the New York State College of Ceramics, Alfred, N. Y. While in college, he was a member of Beta Pi Kappa and Kappa Psi Upsilon and participated in football and wrestling. He was also a student assistant in chemistry.

Mr. Bryant was employed by the C. Pardee Works, Perth Amboy, N. J., the Cambridge Tile Mfg. Co., Cincinnati, Ohio, and the Lisk Mfg. Co., Ltd., Canandaigua, N. Y., before becoming associated with the Ferro Enamel Corporation in 1936.

## RALPH BEVIS MANAGER OF FERRO SOUTH AMERICAN PLANT

The Ferro Enamel Corp., Cleveland, Ohio, has announced the appointment of Ralph Bevis as manager of its branch plant in Buenos Aires, Argentina.

Mr. Bevis, a graduate of the University of Illinois with an M.S. degree in Ceramic Engineering, was transferred in 1927 from the Ferro research staff in Cleveland to Ferro Enamel S. A., Buenos Aires, and placed in charge of the technical control and service of this branch.

His enamel service duties have necessitated frequent visits to the neighboring republics of Uruguay and Chile and, as in Argentina, his training and experience in the enamel field have immeasurably assisted in the rapid development of the porcelain enameling industries of these countries.

Mr. Bevis is the author, with G. H. McIntyre, of a paper entitled "Frit Solutility, I" published in the September, 1936, issue of *The Journal of The American Ceramic Society*.

He is a member of The American Ceramic Society and of Keramos.

## CERAMIC ENGINEERS NOW LISTED IN SELECTIVE SERVICE BULLETIN*

September 18, 1943

Dear Mr. Kelsey:

This is to advise you of a recent action of the Essential Activities Committee of the War Manpower Commission relating to the deferment of students in ceramic engineering.

The Committee has added "Ceramic Engineers" to the scientific and specialized fields listed in Selective Service Activity and Occupational Bulletin No. 33-6, Educational Services—Student Deferment. The regional, state, area, and local offices of the War Manpower Commission, as well as the local boards of the Selective Service System, are being advised of this action.

Insofar as the Selective Service classification of a registrant is concerned, it is primarily the responsibility of the local board to interpret the bulletins and to apply them in cases of specific activities or occupations. Inclusion of an activity or occupation in a bulletin does not assure occupational deferment nor does exclusion from a bulletin, except in the case of nondeferrable activities or occupations, preclude consideration for deferment from military service.

Subject to the right of appeal, the classification of a registrant is determined on an individual basis by the local board upon consideration of all the evidence submitted. In filing a request for occupational deferment of a registrant, one must furnish all evidence necessary to classify the registrant, including full information to support the claim that the activity or occupation in which the registrant is engaged is necessary to the support of the war effect.

Sincerely yours,
COLLIS STOCKING, *Chairman,*
*Essential Activities Committee,*
*War Manpower Commission*

* Letter to V. V. Kelsey, *Chairman,* Public Relations Committee, The American Ceramic Society, Inc.

## LETTER FROM WAR DEPARTMENT

Headquarters Army Service Forces,
Washington, D. C.,
October 5, 1943

Dear Mr. Purdy:

Your letter of September 30 giving information regarding the need of technical men in the ceramic industry is acknowledged.

The Army Specialized Training Division arranges training only upon the request of using Arms and Services within the United States Army. It would, therefore, be impossible for inclusion of training of ceramic engineers in the Army Specialized Training Program unless this request came through the Signal Corps, Ordnance, or other Army organizations.

Very sincerely yours
(Signed) HERMAN BEUKEMA,
*Colonel, G.S.C.,*
*Director, Army Specialized Training Division*

# NECROLOGY

## VERGIL MULHOLLAND

Word has been received of the death on October 13 of Vergil Mulholland, a member of The American Ceramic Society for twenty-nine years.

Born July 8, 1877, in Selma, Ill., Mr. Mulholland attended grade school in Dayton, Ohio, and high school in St. Louis, Mo. He then attended Washington University in St. Louis for two years.

After working for some time with a power company in St. Louis, Mr. Mulholland joined Heyl & Patterson, Pittsburgh, Pa., as an engineer in 1902. From 1911 to 1914, he was in charge of installation and development for the Thatcher Mfg. Co., Elmira, N. Y., and from 1914 to 1917, he was associated as engineer with the Darlington Clay Products Co., Darlington, Pa. Since 1917, he had been with the Hartford-Empire Co., Hartford, Conn., as engineer and development supervisor.

Mr. Mulholland held a large number of glass patents, many of which represented his work on the Hartford lehr, improved melting furnaces, furnace forehearth practice, and glass manufacture through the application of proper combustion principles.

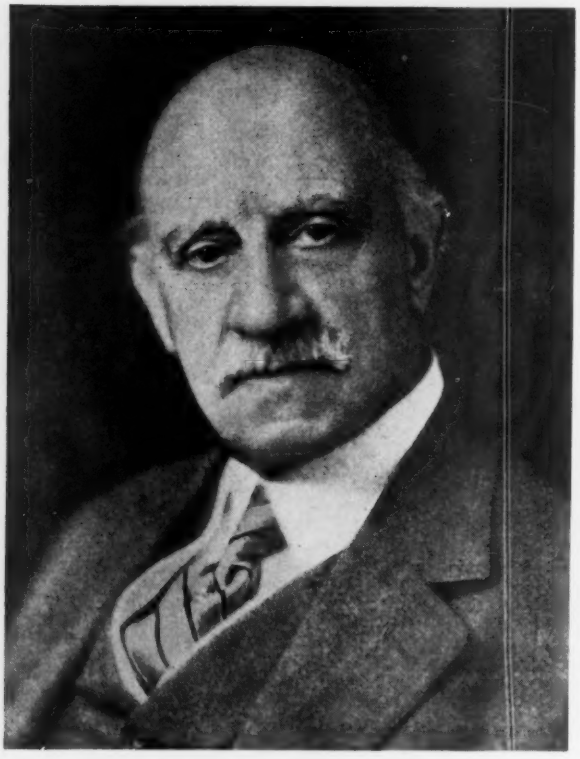
Mr. Mulholland joined The American Ceramic Society as an Associate Member in 1914 and became an Active Member in 1916. Affiliated with the Glass Division, he was elected to the Fellowship of The Society in 1939.

He was also a member of the American Society of Mechanical Engineers and the Hartford Engineers Club.

## HAL WILLIAMS HARDINGE*

Hal Williams Hardinge, mining and metallurgical engineer and inventor, died September 15, 1943, at his home in Forest Hills, Queens, N. Y. He would have been eighty-eight years old September 30.

* From the *New York Herald Tribune*, Sept. 16, 1943.



Hal Williams Hardinge

Mr. Hardinge, recipient of many medals and other awards for his contributions to the mechanical arts, was chairman of the board of the Hardinge Company, Inc., New York, N. Y., which operates a mining and milling equipment manufacturing plant at York, Pa. He retired from active participation in the Company's business in 1939, when he resigned as president.

Mr. Hardinge held more than sixty patents. One of his most important inventions was the conical ball mill, an apparatus for the fine grinding of ores, which he invented in 1906. For this he received the James Douglas Gold Medal of the American Institute of Mining and Metallurgical Engineers thirty-two years later. He also won the John Scott Medal awarded by the City of Philadelphia in 1915 for his "advancement of the mechanical arts."

### Still Inventing at Eighty

One of Mr. Hardinge's early inventions was a telthermoscope and fire-damp detector, a device to detect coal gas in mines, which he patented in 1888. In 1890, he invented a forehearth for smelting furnaces. He was manager of mines and smelters in the West for many years.

On his eightieth birthday he was still working on new inventions and trying to improve his old ones. He also devoted considerable time to finding new and improved forms of incandescent gas light.

Mr. Hardinge investigated and reported on the potential value of gold, iron, diamond, nickel, and silver mines in all parts of the world. During World War I he was a dollar-a-year man in the Bureau of Mines at Washington.

Mr. Hardinge was born in San Antonio, Texas, a son of the late George and Sarah Bumstead Hardinge. He lived in Boston and Brooklyn, where he left school at the age of thirteen and became a printer's devil. When he was fifteen, his family moved to Buffalo, where he became a newsboy on New York Central trains.

### Prospected for Gold

Mr. Hardinge learned telegraphy and stenography, visited and studied the wonders of the 1876 Centennial Exposition in Philadelphia, became a telegraph operator, and took special scientific courses at Philadelphia High School and Franklin Institute.

From 1881 to 1883, he studied at the Colorado School of Mines and then to support himself cut short his schooling and prospected for gold near Leadville, Colo. He soon quit prospecting for a job as assayer and chemist for the Arkansas Valley Smelting Company, Leadville, after which he directed his ingenuity to inventing and engineering.

Mr. Hardinge held an honorary degree of mining engineer from the Colorado School of Mines and in 1927 was elected a member of Tau Beta Pi, honorary engineering fraternity, by the Alpha Chapter of Colorado. He was a member of the Engineers' Club and the Mining Club.

Surviving are his widow, Mrs. Bertha Wilson Hardinge; a son, Harlowe Hardinge, of York, Pa., also an inventor and president of the Hardinge Co.; and a daughter, Mrs. Granville F. Greening, of Albany, N. Y.

# NOTES FOR CERAMISTS

## CERAMIC INSTRUCTOR POSITION OPEN IN HONDURAS

October 14, 1943

My dear Mr. Purdy:

The American Embassy in Tegucigalpa, Honduras, has informed the Department that the Escuela Nacional de Bellas Artes is interested in obtaining the services of an instructor in ceramics. It has furnished the following information concerning the Escuela Nacional de Bellas Artes, of which Señor Arturo López Rodezno is the Director:

"The ceramics classes at the School now have about thirty full-time students enrolled and the Director is anxious to develop the program, not only as a means of providing an outlet for the talent of the students, but to revive and improve a national industry which has all but died out in many parts of the country. The present program of the School calls for providing one or more graduates from each part of Honduras, with sufficient materials and tools to return to his home town and set up a small ceramic industry there. As practically all of the students at the School are poor boys, compelled to earn their own living, the plan seems to have a good chance of success. An additional outlet for their training will be the new ceramic factory to be built in Tegucigalpa, the machinery for which has already arrived from the United States. In this program Sr. López Rodezno has the personal backing of President Carias, who is the principal patron of the School and, together with Sr. López Rodezno, is mainly responsible for the existence and vigorous growth of this important artistic and vocational training center.

"The School already makes a good deal toward its running expenses by selling quantities of glazed earthenware plates, cups, saucers, bowls, etc., made by its students. These articles are a boon to the average Honduran who cannot afford to buy imported tableware, however simple, because of high transportation costs and dealers' profits. The cheapest cup in Tegucigalpa costs 25¢ and a plain white plate sells for 50¢. Prices in the interior are much higher. The quality of the articles sold by the School, while not yet remarkable, has improved year by year, and with a competent instructor and imported glazing materials, there is plenty of talent among the students to produce really fine pottery. The first lot of imported glazing materials has already been received and will shortly be put into use. A new and well-designed wing of the School is being completed for the work of the ceramic section.

"Sr. López Rodezno states that, although the School cannot at present afford to bring a ceramic expert from the United States and pay his entire expenses and salary, the School is prepared to pay up to $100 monthly towards such expenses.

"In view of the excellent work which has been done at the Escuela Nacional de Bellas Artes since its foundation in 1941 and the direct bearing of the ceramic program on the promotion of small industries and the improvement of the standard of living in Honduras, the Embassy hopes that it may be possible to give sympathetic consideration to this request. The Escuela Nacional is one of the most worth-while and promising enterprises in Honduras, not only by reason of its tangible results, but also because it gives the country something to be proud of, and this is a country whose national morale needs boosting."

It is believed that the Department may be able to offer a professorial mission to a qualified person which would cover travel to and from Honduras plus expenses en route and a supplemental salary.

HARRY H. PIERSON,
*Acting Assistant Chief, Division of Cultural Relations, Department of State, Washington, D. C.*

## CERAMIC SOCIETY OF THE SOUTHWEST

The Ceramic Society of the Southwest held its semi-annual program meeting at the University of Texas, Austin, Texas, October 15 and 16, 1943. This is the third such meeting since the society was organized, and interest has been mounting steadily. Over fifty members and visitors were in attendance.

The following program was presented:

**First Session, October 15, 2:30 P.M., President Ray W. Pafford, Acme Brick Co., Fort Worth, Texas, presiding**

(1) "Progress Report on Treating of Texas Clay" by CARL M. FURGASON, University of Texas.

DISCUSSION: ROBERT H. ANWYL, Elgin Standard Brick Mfg. Co., Elgin, Texas, and the University of Texas; and MELVIN A. NOBLES, University of Texas.

(2) "Water Smoking" by TOM J. BUTLER, JR., Elgin-Butler Brick Co., Austin, Texas.

DISCUSSION: Led by J. W. KELLY, Acme Brick Co., Tulsa, Okla.

**Second Session, October 16, 9:30 A.M.**

(1) "Firing Tunnel Kiln" by LELAND SMITH, Acme Brick Co., Malvern, Ark.

DISCUSSION: Led by CHARLES L. SEWELL, Acme Brick Co., Malvern, Ark.

(2) "Firing Periodic Kiln" by CHARLES C. LAKE, Marshall Brick Co., Marshall, Texas.

DISCUSSION: Led by T. J. ORRENDER, Garrison Brick & Tile Co., Garrison, Texas.

On Saturday afternoon most of the membership attended the Arkansas-Texas football game. Frank Mahurin, president of the Reliance Clay Products Co., Mineral Wells, Texas, and vice-president of the society, urged that the next meeting be held at Mineral Wells, and the invitation was received with unanimous approval.

## ENAMELED UTENSIL MANUFACTURERS' COUNCIL

A general meeting of the Technical Committee of the Enameled Utensil Manufacturers' Council was held in the Department of Ceramic Engineering at the University of Illinois, Urbana, Ill., September 13 and 14. The meetings were attended by the technical representatives of all the member companies making porcelain-enameled kitchen utensils and hospitalware. The Enameled Utensil Manufacturers' Council has sponsored a cooperative project at the University of Illinois, in the Engineering Experiment Station, directed by A. I. Andrews of the Department of Ceramic Engineering, for the past three years.

The general purpose of the meeting was to familiarize the technical representatives with the various test methods and the results obtained on the work done on the Fellowship. In addition, the commercial standards for the industry as well as Government specifications covering porcelain-enameled utensils were discussed. The discussions were directed by A. I. Andrews, F. A. Petersen, and R. L. Cook, all of the Department of Ceramic Engineering.

The program for the two-day session was as follows:

**Monday, September 13**

MORNING: Registration at the Ceramics Building.

1:00 P.M.: Group luncheon—Kammerers on Lincoln and Nevada.

2:00 P.M.: Address of welcome by DEAN M. L. ENGER, followed by discussion of test methods, viz., (1) impact, (2) solubility, (3) thermal shock, (4) reflectance, (5) measurement of enamel thickness, (6) determination of cracks and pinholes in enamel surfaces, and (7) bond.

7:00 P.M.: Group dinner at the Urbana-Lincoln Hotel. Guest speaker, D. S. HUNTER, Enameled Utensil Manufacturers' Council, Cleveland, Ohio. Title of address, "The Kitchenware Industry Now, and the Postwar Period."

**Tuesday, September 14**

9:00 A.M.: Discussion of (*a*) data and comparison of ware now being manufactured; (*b*) enamel standards: (1) commercial standards, (2) proposed commercial standards, and (3) Government specifications.

12:00 M.: Group picture.

12:15 P.M.: Group luncheon—Kammerers on Lincoln and Nevada.

1:30 P.M.: Discussion of variables and conditions which affect enamels: (1) impact resistance, (2) solubility resistance, (3) thermal-shock resistance, (4) reflectance, and (5) bond.

### SUMMARY OF HUNTER ADDRESS

Mr. Hunter surveyed the enamel utensil industry in the past, during the present period, and for the postwar period.

In summarizing the developments in the past, Mr. Hunter pointed out that even twenty-five years ago the volume of sales in the enameled utensil industry amounted to about twenty-five million dollars. Shortly after the last war, aluminum ware, stainless steel, and later glass tended to take a portion of this market so that in the depression years the total volume had decreased to around eight million dollars. The enamel industry lost this market because they neglected to consistently improve the quality of their ware.

In the present period, the volume of sales had increased in 1941 to 18 million, in 1942 to 22 million, and in 1943 to 27 million. Sales for the fiscal year ending July 1, 1944, may reach 30 million. Of this total, the armored forces and other Government agencies may require a total of 14 million, and normal civilian requirements will be left the remaining 16 million. Also during the present period there is a demand for 2 to 3 million dollars' worth of ware by the Office of Economic Warfare for the export trade.

For the period immediately following this war, the industry may enjoy good business conditions. Thereafter, following this boom period there probably will be a business slump, and as in all such periods the competition becomes more severe. The enameled utensil manufacturers should continue to strive to improve the quality of their ware and to work in closer cooperation with the other enamel manufacturers so as to present a more concerted front to other competition.

Following Mr. Hunter's address, A. I. Andrews showed several reels of colored pictures which he had taken of the National Parks on his trip through the western part of the United States.

The following men attended the meeting:

E. H. Kelsey and Bob Gorby, Columbian Enameling & Stamping Co., Terre Haute, Ind.; E. A. Schwarz, Crunden Martin Mfg. Co., St. Louis, Mo.; A. J. Vollrath, Polarware Co., Sheboygan, Wis.; B. S. Kirk, Belmont Stamping & Enameling Co., New Philadelphia, Ohio; J. C. Vollrath and Carl Rickmeier, Vollrath Co., Sheboygan, Wis.; H. C. Jurs and Carl Strobach, Jones Metal Products Co., West Lafayette, Ohio; W. H. Wolf, Strong Mfg. Co., Sebring, Ohio; E. C. Dexheimer and George Foehse, National Enameling & Stamping Co., Granite City, Ill.; O. E. Mulvane, Moore Enameling & Mfg. Co., West Lafayette, Ohio; P. A. Mallonn, Republic Stamping & Enameling Co., Canton, Ohio; F. J. Hodnick, Canton Stamping & Enameling Co., Canton, Ohio; Charles Kapner, Max Reiss, and Paul Huppert, Bellaire Enamel Co., Bellaire, Ohio; Sam Chambers and Lonnie Ashby, U. S. Stamping Co., Moundsville, W. Va.; D. S. Hunter, Enameled Utensil Manufacturers' Council, Cleveland, Ohio; G. A. Brandow, Lisk Mfg. Co., Ltd., Canandaigua, N. Y.; E. F. Fife, Fletcher Enamel Co., Dunbar, W. Va.; and H. C. Arnold, Federal Enameling & Stamping Co., Pittsburgh, Pa.

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## PRODUCERS' COUNCIL, INCORPORATED

### Letter to Subcommittee on Modular Products

Washington, D. C.,
September 7, 1943

This letter summarizes recent progress on the several fronts that are pushing forward to gain acceptance of Modular Standards.

#### Structural Clay Products

The Structural Clay Products Institute is distributing three different publications:

(1) "The ABC of Modular Masonry," a 20-page booklet setting forth the objective, purpose, history, development, and advantages of Modular Masonry. It includes a clear description of brick and tile sizes with tables and illustrations and concludes with commonly asked questions and their answers.

(2) "Modular Size of Clay-Products Units," a 14-page preprint of a technical paper by Harry C. Plummer and E. F. Wanner from the *Journal of The American Ceramic Society* (September, 1943). Well illustrated and forms the basis for application standards.

(3) "Specification for Modular Sizes of Structural Clay Products," a tentative draft submitted to the industry for study and comment.

It has previously been reported that two regions of S.C.P.I., the Hudson River Brick Manufacturers Association and the Facing Tile Institute, have passed resolutions assuring availability of their products in modular sizes without increased cost for postwar projects now being planned. Since, a similar resolution has been passed by Colonial Clays, Inc., of New England. Mr. Plummer has completed part of his United States tour in which he is holding meetings of groups of local brick and tile manufacturers. The least favorable response was in Philadelphia, but even there about three-fourths of those present indicated a desire to go along with modular standardization. There was a good response at Richmond and more recently at Cleveland and Chicago. Favorable expression was practically unanimous at the latter two well-attended meetings.

#### Concrete Masonry

The National Concrete Masonry Association has taken a mail ballot of its membership of concrete and cinder block manufacturers. The result was 102 for and 20 opposed to modification of sizes to conform to modular sizes. E. W. Dienhart, Executive Secretary, reports that a meeting of their Executive Committee is contemplated for September, at which time adoption of Modular Standards will be submitted for formal action. In the meantime, he has requested the assistance of the Modular Service Association in the preparation of a draft of a proposed application standard for their products.

#### Metal Windows

One of the earliest to become interested in this project, the metal window industry has made elaborate studies, yet only recently with the hope of accomplishing genuine simplification. Certain early assumptions seem to have obstructed clear vision of what now appears to be a most simple and logical basis for lightweight steel casement design. This has given new impetus to modular standardization in this branch of the industry, and we will trust W. C. Randall to push this through to a definite postwar commitment.

Modular Standards for Pomeroy Metal Windows have been developed satisfactorily for a postwar hospital project now being designed for New York City.

#### Wood Windows

The A–62 study committee some while ago reviewed its designs with Modular Standards in mind. It was obvious that the New York wood allowance of 4 in. in width and 6 in. in height was at least one basis for coordination that would involve minimum adjustment from existing standards.

The trade association for this branch of the industry is the National Door Manufacturers Association, of which James D. Rowland is President and M. W. Steinbauer is Secretary-Manager. The writer met with these officers on September 2 at Bayport, Minn. The possibilities of Modular Standards were reviewed, and it was decided that the matter be presented by M. W. Adams and the writer to the meeting of the Association in Chicago later in September or early in October. Fred C. Andersen, President, and other officials of the Andersen Corporation were present at this meeting and displayed considerable interest. The Andersen companies claim to have pioneered in the standardization of parts for window frames and sash and demonstrated a successful business in mass production.

**Glass Block**

Glass block has been manufactured in modular sizes since the start of the business in the early thirties. The majority of block are $7^3/_4$ or $11^3/_4$ in. square face. These lay up in $^1/_4$-in. mortar joints so that they space in multiples of 4 in. Even the smaller $5^3/_4$-in. square block conforms when laid in pairs. The only deviation has been a 5- by 8-in. face block introduced to course and space with clay products of the same size.

The glass-block manufacturers are represented on A–62 by Howard B. Vincent, Insulex Division of the Owens-Illinois Glass Co., Toledo, Ohio. Dr. Vincent sees the need for development of application standards showing modular details for installing glass-block panels in masonry or other wall construction, as well as details for window and door openings in glass-block walls. He will cooperate as fast as these can be developed.

**Thermopane**

This is a double or triple windowpane, each glass separated by a $^1/_4$- or $^1/_8$-in. space hermetically sealed at the edges. Such a product is being developed for widespread marketing by the Libbey-Owens-Ford Glass Company of Toledo. It is a factory-made product that cannot be cut in the field to fit a sash opening. Harry Ives, of this Company, sees Modular Standards as the logical answer for dimensional standardization for Thermopane and will assist in the necessary cooperative effort with metal and wood sash manufacturers.

**Structural Wood**

Many studies and developments by lumber manufacturers, distributors, and prefabricators have hinged around modular standardization. The Homasote Company has probably gone further in the commercial development of modular systems than any other company. They have issued considerable literature in the past, particularly a complete manual by F. Vaux Wilson. At present, they are distributing a 16-page booklet describing their method of prefabrication based on Modular Standards.

A recent talk with R. A. Glaze, Chief Engineer of the Weyerhauser Sales Company at St. Paul, discloses many elaborate studies and experiments conducted by that Company, all of which involve basic modular design. Much of this advanced thinking may play a part in the ultimate development of modular application standards in this field.

**Stran-Steel**

The Stran-Steel Division of the Great Lakes Steel Corp., Detroit, has retained two firms of Detroit architects to assist them in postwar structural planning. At a recent meeting with representatives of these groups, the writer covered historical background and Prentice Bradley, of the Modular Service Association, gave a blackboard talk that cleared up the thinking of all present in demonstrating the useful application of modular design methods to their problems.

**Other Progress**

The foregoing high lights the progress that has come to our attention. It is not claimed to be complete. Other progress will be reported in future letters as made known to your Chairman. The decisions reached during the past month indicate clearly that the building industry has never before been in such a favorable mood for acceptance of this advance in the building art.

—FREDERICK HEATH, JR., *Chairman, Subcommittee on Modular Products*

## LIGHT REFLECTIONS REMOVED BY NEW PROCESS

A new method of removing annoying light reflections from glass and other materials has been developed by H. R. Moulton, assistant research director of the American Optical Co., Southbridge, Mass. He is shown in the accompanying photograph looking through a piece of glass, half of which has been treated by the new reflection remover. Light reflections on the right untreated half of the glass conceal his face, which is visible through the left treated portion.

**H. R. Moulton demonstrating the new reflection-removing process**

This discovery, through which large areas of glass and other substances can be made nonreflecting for the first time, is being devoted exclusively to war purposes. Postwar applications include the removal of light reflections from automobile windshields and dashboards, eyeglasses, show windows and cases, paintings, and camera and instrument lenses.

## INDUSTRIAL HYGIENE FOUNDATION

The eighth annual meeting of the Industrial Hygiene Foundation was held November 10 and 11, 1943, at Mellon Institute, Pittsburgh, Pa.

The following program was presented:*

Report to Members by ANDREW FLETCHER, Vice-President, St. Joseph Lead Company and Chairman, Foundation's Board of Trustees, and JOHN F. MCMAHON, Managing Director.

Keynote address by CHARLES F. KETTERING, Vice-President, General Motors Corporation.

"Putting the Veteran Back to Work" (panel discussion).

Presiding: C. D. SELBY, M. D., Medical Consultant, General Motors Corporation; member of Foundation's Board of Trustees and Medical Committee.

Participants: HARLEY L. KRIEGER, M.D., Medical Director, Ford Motor Company; A. A. HENDRIX, Per-

* Preliminary program received in Society offices October 26, 1943.

sonnel Director, Eastern Aircraft Div., General Motors Corporation; COL. J. N. ANDREWS, Executive Officer, Re-Employment Div., National Selective Service System.

MEDICAL SECTION

Presiding: LT. COL. A. J. LANZA (MC), Chief, Occupational Hygiene Branch, U. S. Army; Chairman, Foundation's Medical Committee.

"How the Inhalation of Some Chemicals Affects the Eye" by CHARLES F. KUTSCHER, M. D., Medical Adviser, Industrial Hygiene Foundation.

"Recent Data on Health Hazards in War Industries" by LT. COL. W. J. MCCONNELL (MC) and R. H. FLINN, M.D., Safety and Security Branch, U. S. Army; and LT. COL. RAYMOND HUSSEY (MC), Director, U. S. Army Industrial Hygiene Laboratory.

"Fluorides as an Industrial Health Problem" by ROBERT A. KEHOE, M.D., Director, and EDWARD J. LARGENT, Kettering Laboratory, University of Cincinnati.

"Further Observations on Lung Changes in Electric Arc Welders" by O. A. SANDER, M.D., Medical Committee, Industrial Hygiene Foundation.

"Progress Report on Study of Disability in Silicotics" (a Foundation-supported study) by L. U. GARDNER, M.D., Director, and GEORGE WRIGHT, M.D., The Saranac Laboratory.

MAINTENANCE OF WOMAN AND MANPOWER IN INDUSTRY

"Health Problems of Women in Industry" (findings from a Foundation-supported plant-to-plant study) by C. O. SAPPINGTON, M.D., Industrial Health Consultant, Chicago; discussion by MRS. W. B. HOBART, Adviser on Employment of Women, Office of Secretary of War.

"Health Problems of Older Employee and Employer" by EDWARD J. STIEGLITZ, M.D., Washington, D. C.

"Reducing Man-Power Losses" (including results of Foundation-U. S. Public Health Service study) by W. M. GAFAFER, D.Sc., Senior Statistician, U. S. Public Health Service.

ENGINEERING SECTION

Presiding: PHILIP DRINKER, Harvard School of Public Health; Chairman, Foundation's Engineering Committee.

"Control of Health Hazards in Shipbuilding, Including Welding" by PHILIP DRINKER, Chief Health Consultant, U. S. Maritime Commission.

"Report on Highpoints of Foundation Plant Surveys" by FRANCIS R. HOLDEN, Ph.D., and W. C. L. HEMEON, M.S., Industrial Hygiene Foundation.

"Physiological Effects of Heat" by LT. COL. T. F. HATCH, S.C., Armored Medical Research Laboratory, Fort Knox.

"Application of Engineering Control Measures in Munitions Plants," by ALLEN D. BRANDT, D.Sc., Sanitary Engineer, U. S. Public Health Service.

LEGAL SECTION

Presiding: T. C. WATERS, Mullikin, Stockbridge & Waters, Baltimore, Md.; Chairman, Foundation's Legal Committee.

"Legal Developments in 1943 Respecting Industrial Health" by T. C. WATERS.

"Healthful Working Conditions Improve Labor Relations" by ALMON E. ROTH, Member, National War Labor Board.

## GLASS THAT FLOATS

Glass so light in weight that it floats is the latest development of the Pittsburgh Corning Corp., Pittsburgh, Pa. Called Foamglas, it is a new insulating material also applicable to floats, life rafts, building blocks, and other uses. Formed of a noncritical material, it provides a valuable substitute for items made unavailable or scarce by wartime demands.

Foamglas is a true glass that has been cellulated by the evolution of internal gas at high temperature into a mass of tiny sealed air chambers, as many as 5,000,000 per cubic foot. Impervious to acid atmospheres or solutions and completely verminproof, it can be easily cut into any shape by a cheap saw or knife.

Float made of Foamglas

"He who whispers down a well
About the goods he has to sell
Will never reap the golden dollars
Like he who climbs a tree and hollers."

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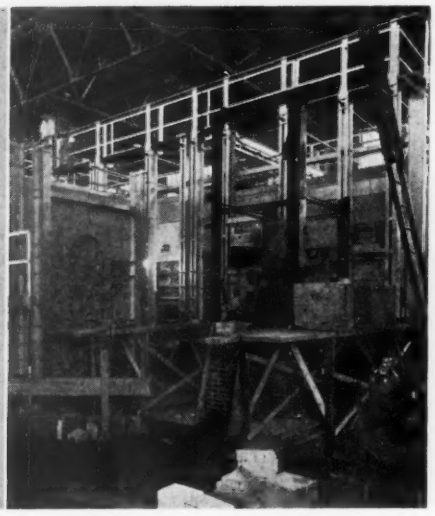

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Norton Co. (*Alundum-Crystolon*)

**Abrasive Wheels: (Diamond impregnated for cutting off brittle materials)**
Felker Mfg. Co.

**Air Conditioning Systems**
Frazier-Simplex, Inc.

**Aloxite (Refractory Products)**
Carborundum Co.

**Alumina (Hydrate and Calcined)**
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., Electrochemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Pennsylvania Salt Mfg. Co.
The Vitro Mfg. Co.

**Alumina (Fused) Brick and Tile**
Electro Refractories & Alloys Corp.
The Vitro Mfg. Co.

**Aluminum Oxide (Calcine)**
The Hommel, O., Co., Inc.
The Vitro Mfg. Co.

**Aluminum Oxide (Fused)**
Carborundum Co.
Electro Refractories & Alloys Corp.
Foote Mineral Co.
Harshaw Chemical Co.
Norton Co.
The Vitro Mfg. Co.

**Alundum (Refractory Products)**
Norton Co.

**Ammonium Bicarbonate**
Du Pont de Nemours, E. I., & Co., Inc., Electrochemicals Dept.
Solvay Sales Corp.

**Ammonium Bifluoride**
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., Electrochemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
The Vitro Mfg. Co.

**Ammonium Carbonate**
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., Electrochemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
The Vitro Mfg. Co.

**Antimony Oxide**
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., Electrochemicals Dept.
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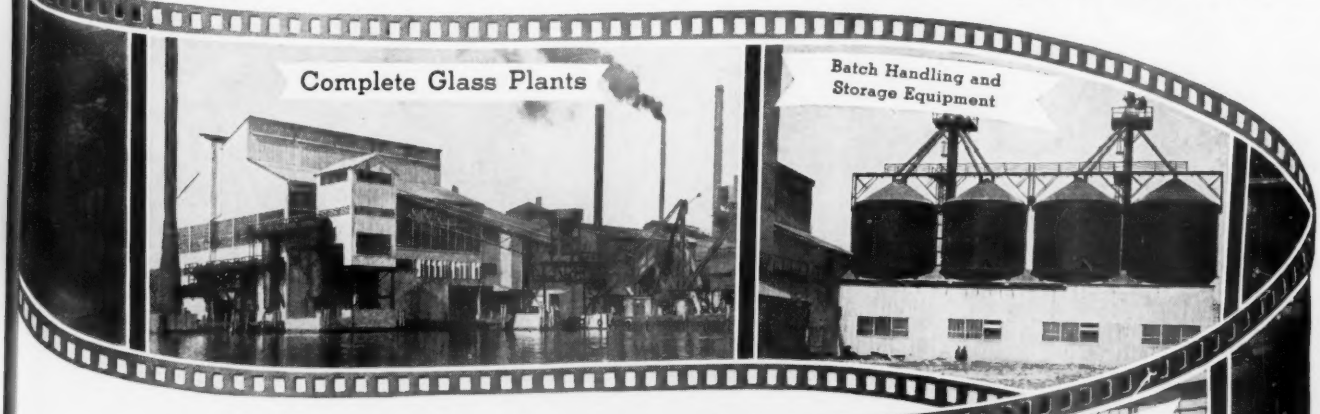

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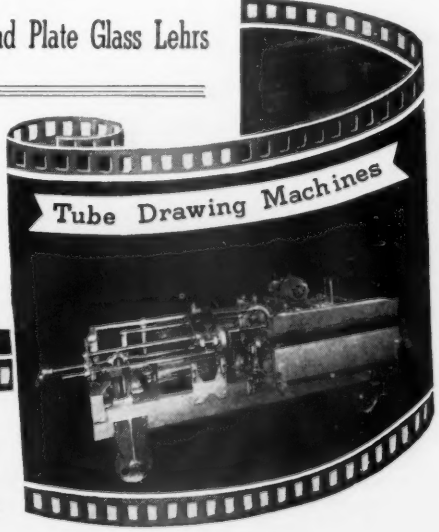


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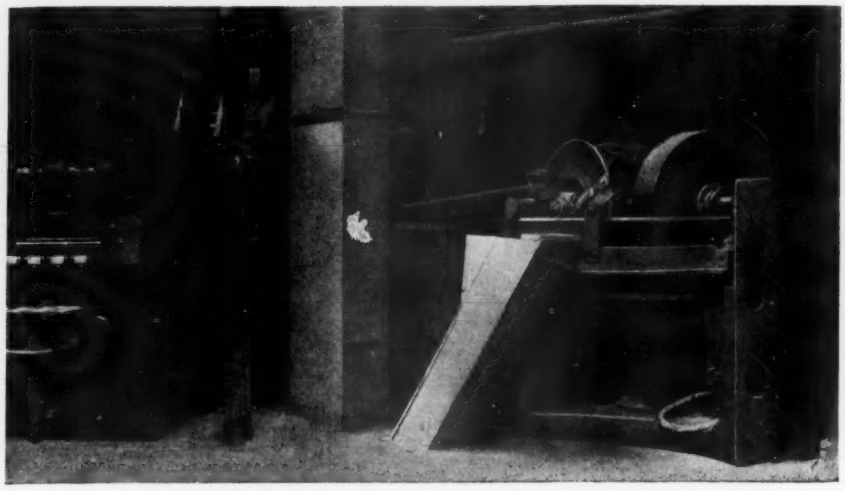

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# Norton Development of Slotted Batts Greatly Increases Their Kiln Life

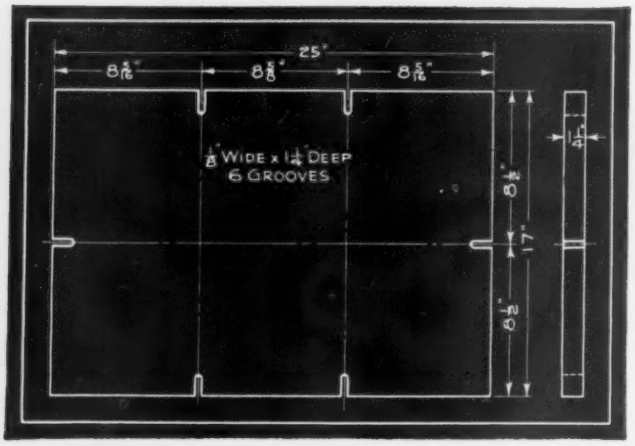
The use by the ceramic industry of continuous kilns has necessitated the development of special refractory kiln furniture.

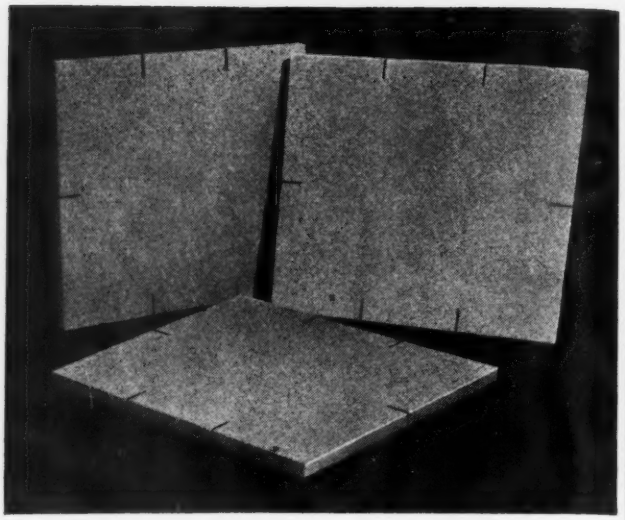
The operating cycles differ markedly from kiln to kiln depending upon the product being heat treated or fired. Some kilns run on cycles as rapid as 24 hours while others operate on cycles as relatively slow as ten days.

Kiln furniture, such as batts, saggers and supports, is subject to various temperature conditions while traveling through the continuous kilns. This temperature differential is perhaps the severest condition to be met of all the conditions refractory materials must withstand.

Within the setting of any kiln car stresses are set up which are caused by the method of applying the heat. That is, heat is applied at right angles to the setting at the outer edge and until a condition of equilibrium is reached, stresses are set up in the setting because of temperature differentials.

During the heating up period the outside of the setting is hotter than the center and will expand more rapidly resulting in a conflict of stresses (i.e. compression at the outside and tension at the center). These stress-strain conditions disappear during the soaking period when temperatures are uniform. But during the cooling period stress-strain conditions reappear in reverse order (i.e. tension at the outside and compression at the center).



To relieve by mechanical means these stresses set up, Norton Company developed the Slotted Batt. These are plates or tile of refractory CRYSTOLON (silicon carbide) material having opening of slots which extend inwardly from the edge to compensate for expansion and contraction of the batt due to thermal changes when in use.

When a rectangular batt is heated around the edges and a circular batt around the periphery, the batt tends to expand in the outer zone where the heat is applied. The central zone being cooler does not expand at the same rate. Finally a point is reached where breakage occurs.

Theoretically the greater the number of slots the more rapidly the plate may be heated or cooled without cracks developing. But there is a practical limit to the number of slots when consideration is given to the need for mechanical strength. However it has been shown that (for example) a batt having two slots per side dividing the side into thirds, will withstand three times the heating (constant rate of heating) that a batt with no slots will stand.

**NORTON COMPANY**
**Worcester 6 Massachusetts**

Du Pont de Nemours, E. I., & Co., Inc., Electrochemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
The Vitro Mfg. Co.

**Gold Decorations**
Du Pont de Nemours, E. I., & Co., Inc., Electrochemicals Dept.
The Hommel, O., Co., Inc.

**Granulators**
Lancaster Iron Works, Inc.

**Grinding Wheels**
Carborundum Co. (*Carborundum and Alozite*)
Electro Refractories & Alloys Corp.
Norton Co. (*Alundum-Crystolon*)

**Hearths**
Carborundum Co. (*Carbofrax* heat treating)
Corhart Refractories Co.
Norton Co. (*Crystolon*)

**Hearths (High Aluminous Clay, Electrically Sintered Aluminum Oxide, Silicon Carbide)**
Carborundum Co.
Norton Co.

**Hydrofluoric Acid**
Harshaw Chemical Co.
The Hommel, O., Co., Inc.

**Iron Chromite**
Harshaw Chemical Co.

**Iron (Enameling)**
American Rolling Mill Co.

**Iron Oxide**
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., Electrochemicals Dept.
Foote Mineral Co.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

**Kaolin**
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Maxson, Elwyn L.
The Vitro Mfg. Co.

**Kilns, China (Decorating)**
Drakenfeld, B. F., & Co.
Frazier-Simplex, Inc.
Harrop Ceramic Service Co.
The Hommel, O., Co., Inc.
Swindell-Dressler Corp.

**Kilns (Electric, Circular, Tunnel)**
Ferro Enamel Corp.
Harrop Ceramic Service Co.
Swindell-Dressler Corp.

**Kiln Furniture (Silicon Carbide, Semi-Silicon Carbide) (Refractory)**
Carborundum Co.
Electro Refractories & Alloys Corp.
Ferro Enamel Corp.

**Kryolith (see Cryolite)**
Pennsylvania Salt Mfg. Co.

**Laboratory Ware**
Norton Co.

**Lehr Tile (High Aluminous Clay, Electrically Sintered Aluminum Oxide, Silicon Carbide)**
Carborundum Co.
Electro Refractories & Alloys Corp.

**Lehrs**
Frazier-Simplex, Inc.
Swindell-Dressler Corp.

**Lehrs (Electric or Fuel Heated)**
Frazier-Simplex, Inc.
Swindell-Dressler Corp.

**Lehr Loaders**
Frazier-Simplex, Inc.

**Linings (Furnace Refractory, Block Refractory Plate, Brick, and Tile)**
Carborundum Co.
Corhart Refractories Co.
Electro Refractories & Alloys Corp.
Norton Co.
The Vitro Mfg. Co.

**Lithium Carbonate**
Drakenfeld, B. F., & Co.
Foote Mineral Co.

**Lithium Minerals**
Foote Mineral Co.

**Loaders (Bucket)**
National Engineering Co.

**Magnesia (Fused)**
Electro Refractories & Alloys Corp.
Norton Co.

**Magnesia (Sintered, Calcined)**
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., Electrochemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Porcelain Enamel and Mfg. Co.

**Magnesite**
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., Electrochemicals Dept.
Foote Mineral Co.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
The Vitro Mfg. Co.

**Magnesite Calcined**
Foote Mineral Co.
The Hommel, O., Co., Inc.

**Magnesium Carbonate**
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.

**Manganese**
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., Electrochemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
The Vitro Mfg. Co.

**Manganese Dioxide**
Drakenfeld, B. F., & Co.
Foote Mineral Co.

**Manganese (Oxide)**
Corhart Refractories Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., Electrochemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.

**Masks (Breathing)**
Drakenfeld, B. F., & Co.

**Metals (Porcelain Enameling)**
American Rolling Mill Co.

**Micronized Products**
Porcelain Enamel and Mfg. Co.

**Microscopes (Polarizing)**
Bausch & Lomb Optical Co.
Spencer Lens Co.

**Microscopes (Stereoscopic)**
Bausch & Lomb Optical Co.
Spencer Lens Co.

**Minerals**
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., Electrochemicals Dept.
Foote Mineral Co.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
The Vitro Mfg. Co.

**Mixers**
Clearfield Machine Co.
National Engineering Co.

**Mixers (Batch)**
Clearfield Machine Co.
Lancaster Iron Works, Inc.
National Engineering Co.

**Mixers (Concrete, Paving, Road Paving, Plaster, Asphalt, Truck, Mortar, Bituminous)**
Lancaster Iron Works, Inc.

**Mixers (Laboratory)**
Lancaster Iron Works, Inc.
National Engineering Co.

**Mold Sanders**
Lancaster Iron Works, Inc.

**Muffles (Furnace) (Laboratory)**
Carborundum Co. (*Carbofrax*)
Electro Refractories & Alloys Corp.
Frazier-Simplex, Inc.
Norton Co.

**Mullers (Batch)**
Clearfield Machine Co.
Lancaster Iron Works, Inc.
National Engineering Co.

**Muriatic Acid**
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Pennsylvania Salt Mfg. Co.

**Needle Antimony**
Foote Mineral Co.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.

**Nepheline Syenite**
Great Lakes Foundry Sand Co.

**Nickel Salts**
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.

**Nitrates (Cobalt, Sodium)**
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc. Electrochemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
The Vitro Mfg. Co.

**Nitre**
Harshaw Chemical Co.
The Hommel, O., Co., Inc.

**Norbide (Norton Boron Carbide)**
Norton Co.

**Olivine**
Du Pont de Nemours, E. I., & Co., Inc., Electrochemicals Dept.

**Opacifiers**
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., Electrochemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Metal & Thermit Corp.
Pennsylvania Salt Mfg. Co.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

**Overglaze Colors**
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., Electrochemicals Dept.
Ferro Enamel Corp.

**Oxides**
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., Electrochemicals Dept.
Ferro Enamel Corp.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Metal & Thermit Corp.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

**Palladium Decorations**
Du Pont de Nemours, E. I., & Co., Inc., Electrochemicals Dept.
The Hommel, O., Co., Inc.

**Pans—Wet and Dry**
Clearfield Machine Co.

**Pins**
The Hommel, O., Co., Inc.
Industrial Ceramic Products, Inc.
Potters Supply Co.

**Placing Sand**
Great Lakes Foundry Sand Co.

**Platinum Decorations**
Du Pont de Nemours, E. I., & Co., Inc., Electrochemicals Dept.
The Hommel, O., Co., Inc.

**Polariscopes**
Bausch & Lomb Optical Co.
Frazier-Simplex, Inc.

**Porcelain Enameling Service (Practical)**
American Rolling Mill Co.
Du Pont de Nemours, E. I., & Co., Inc., Electrochemicals Dept.
Ferro Enamel Corp.
The Hommel, O., Co., Inc.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

**Porcelain Enamels**
Ferro Enamel Corp.
The Hommel, O., Co., Inc.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

**Potash (Carbonate)**
Du Pont de Nemours, E. I., & Co. Inc., Electrochemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Solvay Sales Corp.
The Vitro Mfg. Co.

**Producer Glass Plants**
Frazier-Simplex, Inc.

**Pug Mills**
Lancaster Iron Works, Inc.

**Pyrites (Natural Iron Sulphide)**
Foote Mineral Co.
The Hommel, O., Co., Inc.

**Pyrometer Tubes**
Carborundum Co.
Leeds & Northrup Co.
Montgomery Porcelain Products Co.

**Pyrometer Tubes (Refractory and Hard Porcelain)**
Electro Refractories & Alloys Corp.
McDanel Refractory Porcelain Co.
Montgomery Porcelain Products Co.
Norton Co.

**Pyrometers (Optical, Radiation, Surface, Immersion, Needle)**
Leeds & Northrup Co.

**Pyrometric Cones**
The Edward Orton, Jr., Ceramic Foundation

**Raw Material Handling Equipment**
Frazier-Simplex, Inc.
Lancaster Iron Works, Inc.

**Recorders, $CO_2$**
Leeds & Northrup Co.

**Recorders, Draft**
Leeds & Northrup Co.

**Recorders, Tank Pressure**
Leeds & Northrup Co.

**Refractometers**
Bausch & Lomb Optical Co.
Electro Refractories & Alloys Corp.
Spencer Lens Co.

**Refractories**
Carborundum Co.
Corhart Refractories Co.
Electro Refractories & Alloys Corp.
Norton Co.

**Refractory Materials**
Carborundum Co.
Corhart Refractories Co.
Electro Refractories & Alloys Corp.
Norton Co.
Titanium Alloy & Mfg. Co.

**Respirators**
Drakenfeld, B. F., & Co.
The Hommel, O., Co., Inc.

**Rutile**
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Du Pont de Nemours, E. I., & Co., Inc., Electrochemicals Dept.
Foote Mineral Co.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Metal & Thermit Corp.
The Vitro Mfg. Co.

**Saggers**
Carborundum Co.
Electro Refractories & Alloys Corp.
Norton Co.
Potters Supply Co.

**Salt Cake**
American Potash & Chemical Corp.
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Pennsylvania Salt Mfg. Co.

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**Selenite of Sodium**
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**Selenium**
Drakenfeld, B. F., & Co.
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Foote Mineral Co.
Harshaw Chemical Co.
The Hommel O., Co., Inc.
The Vitro Mfg. Co.

**Sheets (Enameling Iron)**
American Rolling Mill Co.

**Silica (Fused)**
Electro Refractories & Alloys Corp.
Foote Mineral Co.
The Hommel, O., Co., Inc.

**Silicate of Soda**
Harshaw Chemical Co.
The Hommel, O., Co., Inc.

**Silicon Carbide**
Carborundum Co.
Electro Refractories & Alloys Corp.
Norton Co.

**Silicon Carbide Firesand**
Carborundum Co.

**Sillimanite Refractories**
Electro Refractories & Alloys Corp.

**Slabs (Furnace)**
Carborundum Co.
Electro Refractories & Alloys Corp.
Norton Co.

**Soda Ash**
American Potash & Chemical Corp.
Du Pont de Nemours, E. I., & Co., Inc., Electrochemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Pennsylvania Salt Mfg. Co.
Solvay Sales Corp.
The Vitro Mfg. Co.

**Sodium Antimonate**
Drakenfeld, B. F., & Co
Du Pont de Nemours, E. I., & Co., Inc., Electrochemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Metal & Thermit Corp.
The Vitro Mfg. Co.

**Sodium Fluoride**
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., Electrochemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
The Vitro Mfg. Co.

**Sodium Metasilicate**
Harshaw Chemical Co.

**Sodium Nitrite**
Harshaw Chemical Co.
The Hommel, O., Co., Inc.

**Sodium Silica Fluoride**
Du Pont de Nemours, E. I., & Co., Inc., Electrochemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.

**Sodium Uranate**
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel, O , Co., Inc.

**Soot Blowers**
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**Spar**
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The Hommel, O., Co., Inc.
Maxson, Elwyn L.
The Vitro Mfg. Co.

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The Hommel, O., Co., Inc.
Pennsylvania Salt Mfg. Co.
Stauffer Chemical Co.

**Talc**
Du Pont de Nemours, E. I., & Co., Inc., Electrochemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
International Pulp Company

**Tanks**
Frazier-Simplex, Inc.

**Tank Blocks**
Corhart Refractories Co.

**Tanks (Pickle)**
The Hommel, O., Co., Inc.

**Tanks for Raw Material Steel or Concrete**
Lancaster Iron Works, Inc.

**Tile (Floor)**
Norton Co.

**Tile (Muffle)**
Carborundum Co.
Electro Refractories & Alloys Corp.
Norton Co.

**Tile (Refractory)**
Carborundum Co., (*Carbofrax*)
Electro Refractories & Alloys Corp.
Norton Co.

**Tin Oxide**
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., Electrochemicals Dept.
The Hommel, O., Co., Inc.
Metal & Thermit Corp.
The Vitro Mfg. Co.

**Titanium**
Drakenfeld, B. F. & Co.
Foote Mineral Co.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

**Titanium Oxide**
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., Electrochemicals Dept.
Foote Mineral Co.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Metal & Thermit Corp.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

**Trisodium Phosphate**
Harshaw Chemical Co.

**Trucks**
Lancaster Iron Works, Inc.

**Tubes (Insulating)**
Carborundum Co.
McDanel Refractory Porcelain Co.
Norton Co.

**Tubes (Pyrometer)**
Carborundum Co.
Electro Refractories & Alloys Corp.
Leeds & Northrup Co.
McDanel Refractory Porcelain Co.
Montgomery Porcelain Products Co.
Norton Co.

**Uranium Oxide**
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.

**Uranium Oxide (Yellow-Orange-Black)**
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., Electrochemicals Dept.
The Hommel, O., Co., Inc.
The Vitro Mfg. Co.

**Water Softening Plants**
Frazier-Simplex, Inc.

**Wet Enamel**
The Hommel, O., Co., Inc.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

**Whiting**
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., Electrochemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
The Vitro Mfg. Co.

**Winding Drums**
Lancaster Iron Works, Inc.

**Zinc Oxide**
Du Pont de Nemours, E. I., & Co., Inc., Electrochemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
The Vitro Mfg. Co.

**Zircon**
Foote Mineral Co.
The Hommel, O., Co., Inc.

**Zirconia**
Du Pont de Nemours, E. I., & Co., Inc., Electrochemicals Dept.
Foote Mineral Co.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Metal & Thermit Corp.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

**Zirconium Oxide**
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The Hommel, O., Co., Inc.
Titanium Alloy Mfg. Co.

**Zirkite (Natural $ZrO_2$)**
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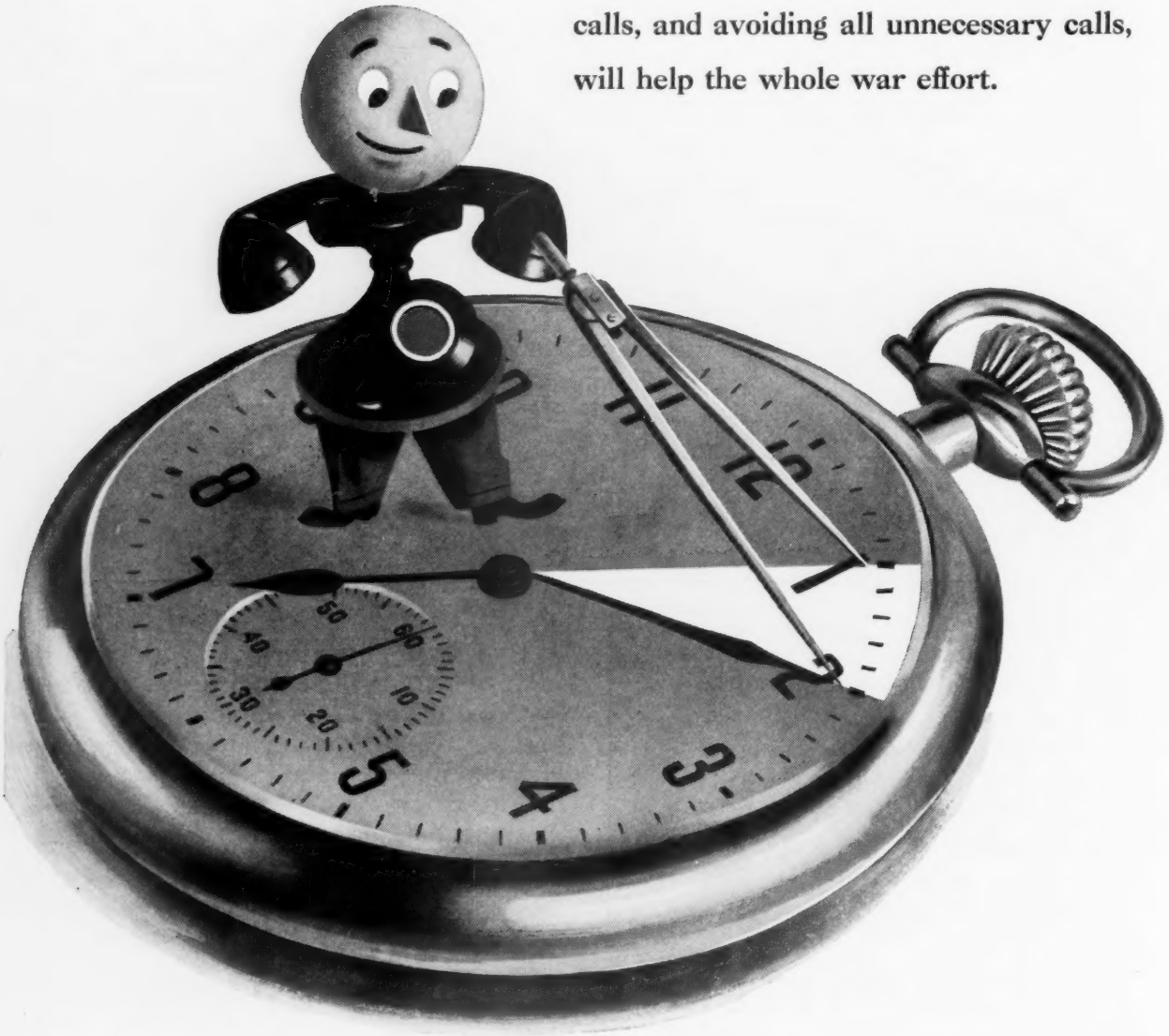

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